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ABSTRACT

Presented are 11 reports resulting from applied research of the Specialized Training Program at the University of Oregon, a subcontract workshop for 15 severely and profoundly retarded adults which focuses on the areas of vocational potential and community program development. Entries include the following titles and authors: "Habilitation of the Severely and Profoundly Retarded--Illustrations of Competence" (G. Bellamy, et al.); "General Utility of Easy-to-Hard Discrimination Training Procedures" (L. Irvin); "Manipulation of Stimulus Features in Vocational Skill Training of the Severely Retarded--Relative Efficacy" (Irvin and Bellamy); "Cable Harness Construction for Severely Retarded Adults--A Demonstration of Training Technique" (J. Hunter and Bellamy); "Habilitation of the Severely and Profoundly Retarded--A Review of Research on Work Productivity" (Bellamy); "The Effects of a Multiple Schedule of Reinforcement with a Bonus Contingency on Response Rate" (A. Fuller); "The Trainee Performance Sample--Toward the Prediction of Habilitation Costs for Severely Handicapped Adults" (Bellamy and S. Snyder); "Community Living for Severely and Profoundly Retarded Adults--A Group Home Study" (D. Close); "Picture Recipe Cards as an Approach to Teaching Severely Retarded Adults to Cook" (M. Robinson-Wilson); "Behavioral Observations for Work Situations--Coding Definition Manual" (N. Todd, et al.); and "Behavioral Observations for Work Situations--Revision for Group Observation" (M. Leiter). (SBH)

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HABILITATION OF THE SEVERELY AND PROFOUNDLY RETARDED:

REPORTS FROM THE SPECIALIZED TRAINING PROGRAM

Edited by G. Thomas Bellamy

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Specialized Training Program
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University of Oregon

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Foreword

Deinstitutionalization of severely handicapped persons is progressing throughout the nation. This movement from institutions to communities may make it possible for these individuals to lead much more normal lives than has heretofore been possible. However, unless community programs and services are developed for the returning individuals, the real possibility exists that we are only exchanging community closets for institution backwards.

From this perspective the volume compiled by the Specialized Training Program is noteworthy in two important respects. First, it focuses on the skills which the severely and profoundly retarded must have to live competently in the community. In developing, evaluating and reporting systematic ways of teaching these skills, the program is contributing greatly to the information needed to provide effective community living opportunities. The vocational orientation of the reports is also timely. A dramatic need exists to develop community work opportunities for the severely and profoundly retarded. The information included here should increase their success when such opportunities are provided by making vocational training, supervision and evaluation procedures more effective, more efficient and more practical.

A second, and perhaps more important, aspect of this work is the type of research it represents. The Specialized Training Program is a service program which is designed to utilize previous research information. With this service emphasis, the program must deal with the same day-to-day problems that are faced in similar programs outside the university. These daily problems, rather than theoretical questions, are the focus of the research reported here. Solutions and answers are sought which are practical within typical constraints of community service programs.

As this emphasis on practicality continues, subsequent reports from the Specialized Training Program should make it easier for other programs to apply current research findings. In this way the gap between research and practice may be lessened in services for severely and profoundly retarded adults.

R. Sidney Justice, DSW.
March, 1976

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Introduction

This volume was compiled to facilitate rapid informal dissemination of research and demonstration activities in the Specialized Training Program at the University of Oregon. The Specialized Training Program is a subcontract workshop for fifteen severely and profoundly retarded adults, most of whom were previously institutionalized and excluded from both educational opportunities and rehabilitation programs. The program was developed because of the likelihood that severely and profoundly retarded adults would live in increasing numbers in their home communities and that community programs would be expected to meet their education and habilitation needs. Research in the Specialized Training Program has been designed to provide practical information which may help other community agencies attempting to meet these needs. The papers in this volume are the initial results of this practical research effort.

Residential trends. The need for research on community program development is readily apparent when residential trends affecting severely and profoundly retarded adults are examined. The number of these adults living in their home communities, and thus requiring community education and habilitation services, can be expected to increase as a result of three apparent directions in service delivery. The first and possibly most dramatic is the rapidly increasing availability of public school services to all children. Continued litigation, state legislation, and program priorities of several federal agencies indicate that these services will continue to obviate the need for initial institutionalization.

Second, policies of deinstitutionalization, which have been promoted by several social services during the last few years, have resulted in community placements of many severely handicapped adults. Continued belief that community living is more normative (Wolfensberger, 1972) and possibly less costly (Rosen, 1975) will likely increase community placements still further.

A third basis of support for community residence for severely handicapped adults derives from occupational areas. The Vocational Rehabilitation Act of 1973 emphasizes services to severely disabled adults, and although the severely disabled category is considerably broader than the severely handicapped group of concern here, the latter group certainly is included.

Need for community programs. The trends noted above do suggest that many severely and profoundly retarded adults will be community rather than institutional residents. Given this result, community programs will be expected to meet their education and habilitation needs. However, few community programs now provide these services. This is illustrated, for example, by Rowitz, O'Connor and Boroskin (1975), who reviewed the services available to severely and profoundly retarded adults in one western state. Less than seven percent of all services received by this group could be labeled "vocational", and a similarly small percentage of services to adults was labeled "educational". Similar comments on the inadequacy of community programs here in Oregon are provided by Crowley (1975) and the Oregon Association for Retarded Citizens

(1973). Both have spoken against continued placements outside the major institutions until day programs are available in more of the state's communities.

Most severely retarded adults have also been excluded from vocational rehabilitation services inasmuch as the characteristics which define them as severely retarded have also defined them as unfeasible rehabilitation clients. Indeed, because of the paucity of community programs equipped to provide needed services, this categorization may have been a practical one.

Program goals. One of the first steps in developing the needed education and habilitation programs in local communities involves clearly specifying the objectives of these programs. Toward what ends should daily programs be directed? What can be considered an adequate community service? Current technologies of skill training and behavior change have greatly increased the available options in community programs, but they have not reduced the necessity of defining program objectives in terms of professional values or ideologies (Bandura, 1969).

Three generally accepted professional values appear relevant to the definition of community program objectives. The most familiar of these values is that of normalization, defined by Nirje (1969) as "making available to the mentally retarded patterns and conditions of everyday life which are as close as possible to the mainstream of society" (p. 181). A closely related concern is the emerging legal right to treatment in the least restrictive alternative setting.

A second professional value frequently encountered in the literature is an acceptance of a developmental model (Roos, 1975). In this model it is assumed that behavior can be changed by environmental events and that individual progress can be measured by noting increases in the complexity of behavior and the variety of environments to which one has adapted.

An additional set of values relates to the personal competence and independence of handicapped individuals (Edmonson, 1974). For example, individuals should be able to choose among alternate goals and activities, have skills necessary for independent behavior and mobility, and be able to perform skills which are valued by society around them.

Several authors have derived specific standards for community vocational programs from some or all of these values (Gold, 1973; Olshanski, 1972; Wolfensberger, 1967). None of these focuses specifically on the more severely handicapped and sets guidelines for relative emphasis on needed occupational and educational services. In the development of the Specialized Training Program these values led to the belief that services for severely and profoundly retarded adults should maximize the ability of these individuals to participate competently in a broad spectrum of community activities. This is apparent in the following program assumptions:

(1) Work is a normal and respected part of our society, and community programs should provide the opportunity for severely and profoundly retarded adults to perform personally rewarding work for competitive wages.

(2) Community programs should insure that individual adults receive skill training as needed to increase personal opportunities and choices in the community. They should receive this training as competent adult workers, not as continuing pupils, and this implies that day programs be primarily vocationally, not classroom oriented.

(3) Community programs should insure that support services are available when individual skills are not yet adequate for community participation.

It follows from these assumptions that daily community programs for severely retarded adults should develop economically useful vocational skills, allow individual workers to earn wages performing these skills, and then pro-

vide educational and support services as needed for community participation. This suggests that programs which maintain severely retarded adults in the community in the role of pupils or children should be specifically avoided. Obviously, extensive education and training services are needed by most severely and profoundly retarded adults before they can participate in many aspects of community life. However, reliance on a day program for all of these services can be reduced by the development of effective residential programs, evening adult education classes, and community recreational opportunities. The long range function of a day program can thus be the provision of vocational opportunities as a reflection of normal activity patterns.

Development of the Specialized Training Program. With these objectives in mind the Specialized Training Program was begun in the University of Oregon Center on Human Development in 1973. At that time it was apparent that existing program models were unlikely to accomplish the objectives with the many severely and profoundly retarded adults living in their communities. The Specialized Training Program was thus designed as a model community program. Its approach has been to combine previously reported research and practice in an attempt to provide exemplary services, to identify problem areas and program failures as areas for future research, to conduct that research, and then to integrate relevant results into the service program.

Considerable effort was made initially to insure that the population served in the program would be as representative as possible of a larger population of severely and profoundly retarded adults. This was done in two ways. The first six workers represented all the known severely and profoundly retarded adults within commuting distance of the program who had no obvious motor and sensory deficits. Five of the remaining nine were included by random selection of this county's residents from the state institution who met the same criteria. These essentially random selection procedures were designed to insure that the problems encountered in the Specialized Training Program and the resulting research directions in the program would be as representative as possible of those which will be encountered when more community services are provided these adults.

The contents of this volume resulted from the applied research orientation of the Specialized Training Program during its first two years. The first section combines our own work with previous research to affirm the vocational potential of severely and profoundly retarded adults. A section on vocational training follows, in which the relative efficiency of various discrimination training techniques are compared and a detailed training procedure for one apparently complex subcontract is presented. The third section focuses on the supervision of production after training is completed. It includes a review of research on supervision and productivity and a description of procedures used with one worker in the Specialized Training Program. In the next section a paper on vocational assessment presents initial research on a new instrument. Community living is the focus of the fifth section, with papers describing a group home for the severely and profoundly retarded and evaluating the utility of picture recipes in a cooking program.

The final section includes detailed descriptions of two naturalistic observation assessment devices with which we are evaluating some of the results of the Specialized Training Program. Many instruments are now available for assessing skill development and evaluating programs on the basis of skill acquisition. Although these are important program outcomes, they do not provide a clear picture of an individual's day-to-day behavior and environments. The two behavior observation codes thus represent initial efforts at applying naturalis-

tic observation techniques to the problem of program evaluation. If vocational programs are successful, they should produce changes not only in productivity, but also in other behaviors like stereotypy, social responses, and task attending. Our research in the area of naturalistic observation has progressed from a detailed description of a single worker's behavior to the use of time sampling techniques so that observations could be recorded on ail workers in the production area. Our current research involves adapting this latter system for use by production supervisors, thereby eliminating the need for full time observers.

Support from several sources has made the work reported here possible. The University of Oregon University Affiliated Facility has administered the program and has provided extensive financial and professional assistance. Support for specific research activities and assistance in the development of the community group home was provided by the Office of Developmental Disabilities, Region X. Substantial support has also been provided by the University of Oregon Rehabilitation Research and Training Center in Mental Retardation and the Oregon Mental Health Division and Vocational Rehabilitation Division.

Many of the papers included in this volume have also been submitted for publication to professional journals. It is difficult within the space typically allowed in these journals to express adequate appreciation to individuals whose efforts or influence have made substantial contribution. I would like to take this opportunity, therefore, to thank: Dr. Robert H. Schwarz, Director of the University of Oregon Center on Human Development, whose encouragement and assistance has been a major factor in the growth of the Specialized Training Program; Dr. Sidney Justice, Director, Region X Developmental Disabilities Office, whose advice and support have helped maintain the program as a relevant community-based service; and Dr. James Crosson and Dr. Marc Gold, whose pioneering work stimulated most of the original interest and motivation in the development of the Specialized Training Program. A special note of thanks is also due Mary J. Moffat, for editorial assistance, and Arden Munkres, whose graphics add tremendously to the readability of each paper.

G. Thomas Bellamy
March, 1976

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DEMONSTRATION

Habilitation of the Severely and Profoundly Retarded: Illustrations of Competence

G. Thomas Bellamy, Lesli Peterson and Daniel Close
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Abstract

Severely and profoundly retarded adults appear able to benefit from significantly more vocational opportunities than are typically provided. Examples of work tasks currently performed by this group are presented in order to emphasize their vocational abilities, and successful training and supervision procedures are illustrated.

The authors express appreciation to Dr. Larry Talkington, Superintendent, Fairview Hospital and Training Center, for his support of the training illustration and to Ms. Patricia Chamberlain and Ms. Nancy Golden for their assistance.
This paper was originally published in *Education and Training of the Mentally Retarded*, 1975, *10*, 174-186. Reprinted with permission.

Habilitation of the Severely and Profoundly Retarded: Illustrations of Competence

As a result of litigation and legislation, an increasing number of severely and profoundly retarded adults are being served in organized daily programs. The inclusion of vocational opportunities in these programs is consistent both with popular treatment philosophies and with previous demonstrations of ability. However, perusal of professional literature suggests vocational involvement with this group is rare, and the few reports which are available describe work tasks which do not reflect their currently apparent vocational potential. Therefore, the purpose of this paper is to raise professional expectancies about the possible vocational abilities of the severely and profoundly retarded and to provide specific illustrations of effective training procedures and work supervision methods.

The trend toward participation is particularly applicable to institutions. There, programs should be stimulated by continuing professional interest in habilitation (Wolfensberger, 1967; Gold, 1973) and by legal action suggesting that all institutionalized persons may have a right to treatment (Wyatt *v.* Anderholt, 1972). In keeping with the movement toward deinstitutionalization, programs can be expected to be more available to adults living in their home communities. State and local agencies are responding to such factors as active involvement of parent and consumer groups in stimulating program development (e.g., Oregon Association for Retarded Citizens, 1973); government guaranteeing public school services for severely and profoundly retarded adolescents (Abeson, 1974); and emphasis on the severely disabled in the Vocational Rehabilitation Act of 1973.

These indications of increased services for severely retarded adults are consistent with increasing professional acceptance of a philosophy of normalization (Nirje, 1970; Wolfensberger, 1972). By proposing as a goal for human services the provision of normative experiences, this philosophy has generated a consensus that all retarded individuals should be helped to lead the most normal lives possible in the least restrictive settings possible. An extension of the normalization goal to vocational involvement (Olshanski, 1972) underlies the present rationale. If normalization has relevance for the severely retarded, not only should day programs be available, but they should also include the opportunity for productive remunerative work as a reflection of normative activity patterns.

Review of professional literature in the fields of vocational rehabilitation and mental retardation suggests that the occupational opportunities proposed here for the severely and profoundly retarded are not widely provided. Although this may indeed reflect earlier research on the motor abilities of this group in test situations (Distefano, Ellis, & Sloane, 1958; Malpass, 1960), it is inconsistent with several demonstrations of trained performance. Three of the six institutionalized adults involved in a series of workshop investigations in an English institution would be considered severely retarded in the current

classification recommended by the American Association on Mental Deficiency (Grossman, 1973). The studies, reported by Loos and Tizard (1955) and Clarke and Heremelin (1955), demonstrate that severely retarded adults could perform such tasks as inserting nails into wooden frames, constructing boxes through a nine-step folding operation, and soldering color coded wires to a television plug. Similarly, Williams (1967) describes the work performed in an institutional sheltered workshop by a profoundly retarded Down's Syndrome adult. Tasks performed included sorting plastic components by shape and stripping flashings from plastic components.

That the vocational ability suggested in these studies can be generalized to other institutionalized severely and profoundly retarded adults is suggested by Crosson's (1967) work. Adult males were randomly selected from that segment of an institution's population which had received no prior vocational training. The selected adults, who were predominantly severely and profoundly retarded, were taught to use a drill press in manufacturing pencil holders, to sand wooden blocks, and to assemble wooden flower baskets. Most of the behaviors required for each task were readily learned. All subjects performed the drill press operation correctly after nine training sessions, while 33 training sessions were required for the last subject to learn the assembly task. Crosson's (1967) results also support those of the two earlier programs in suggesting that severely and profoundly retarded adults could retain skills acquired over relatively long periods; could switch from task to task; could perform without excessive errors; could work with minimal supervision; and would increase productivity in response to incentives for work.

These reports exemplify an applied research and demonstration approach to program development which is still timely, but they do not accurately reflect a currently emerging optimism about the vocational potential of the severely and profoundly retarded. Our own work and that of Gold (1974) suggests that both the apparent difficulty of the work performed and the levels of productivity which can be expected of this population are increasing dramatically. Gold (1974) discussed successful early efforts at extending his vocational training research, which had previously focused in the moderately retarded, to more seriously involved workshop clients. It appears that a 15-piece bicycle brake assembly task can be acquired rather rapidly by this group.

In our work, fifteen severely retarded adults are currently employed and trained in the Specialized Training Program, a subcontract shop which performs small parts assembly work. A brief report of our initial work (Bellamy & Chamberlain, 1974) noted that severely retarded workers had learned to assemble 24- and 26-piece printheads and a 52-piece cam switch actuator, and that production rates often exceeded normal time standards established by contracting industries. This paper will illustrate the work performed in the Specialized Training Program, the training procedures used, and the work rates obtained. The purpose of these illustrations is to focus professional attention on the possibility of providing vocational opportunities to the severely and profoundly retarded, to raise expectations regarding the vocational abilities of this group, and to identify future research needs.

Task Selection

The selection of appropriate tasks for sheltered workshops has led to much speculation and comment but little empirical research. There is even less information about the appropriateness of various tasks for severely retarded workers, although reports of a few work programs have included relevant sugges-

tions. O'Connor and Tizard (1956) selected work for moderately and severely retarded adults which was repetitive, involved no fine movements, could be easily checked, and was not too bulky. Examples presented were filing rough edges from plastic objects and folding cardboard boxes.

Subsequent demonstrations suggested that moderately retarded adults could learn more complex assembly tasks (Tate & Barhoff, 1967, Huddle, 1967; Gold, 1972). Gold (1973) then advocated selection of work tasks which involved several visual discriminations and manipulations, and which thus did require training on new skills. A related approach is Crosson's (1969) suggestion that workshops should not "find work" to match the current abilities of workers, but rather should "find ways" to teach skills required by available work.

These suggestions are essentially speculative, for little research currently relates ultimate productivity of severely handicapped workers to specific task characteristics. Nevertheless, the tasks subcontracted by the Specialized Training Program were selected on the basis of considerations suggested by Crosson (1969) and Gold (1973). Regionally available work was obtained which appeared exceptionally difficult by typical workshop standards and which required considerable training on fine movements and visual discriminations. Four of these tasks are illustrated in Figure 1.

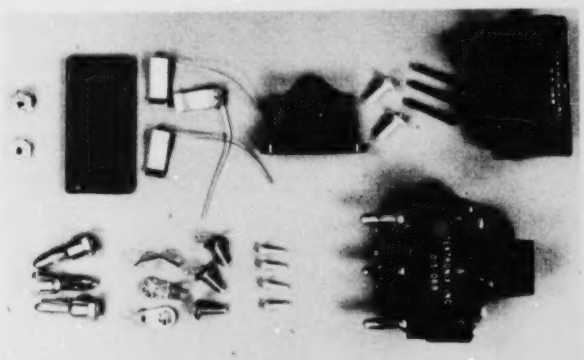

Figure 1 A—26-piece test adapter subcontracted from Tektronix, Inc.

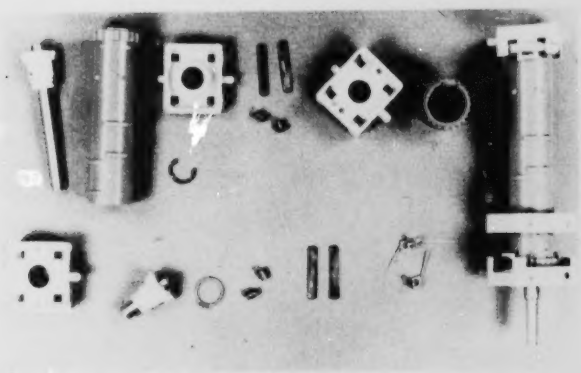

Figure 1 B—19-piece cam switch actuator.

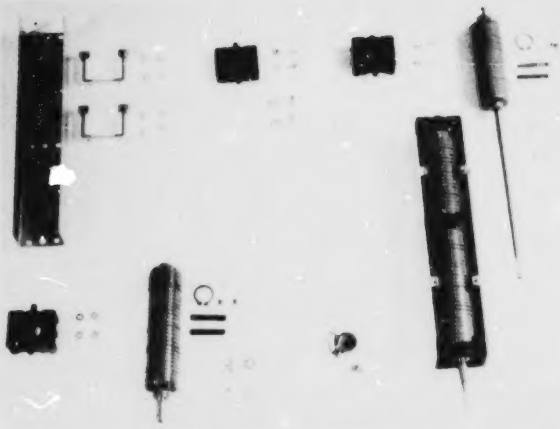

Figure 1 C—52-piece cam switch actuator.

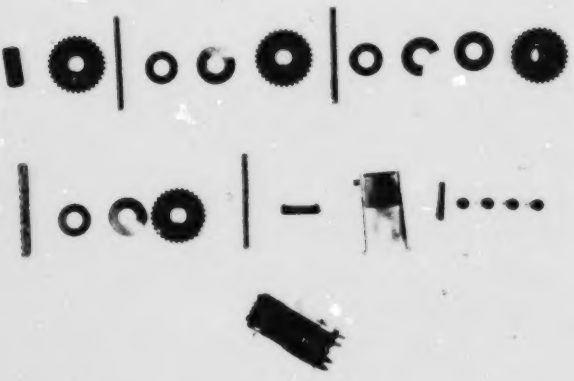

Figure 1 D—23-piece printhead assembly subcontracted from Primark, Inc.

Training Procedures

Vocational training procedures are at issue when completion of a work task either involves behaviors not in a trainee's repertoire or requires that existing behaviors be brought under the control of stimulus cues inherent in the task. Previous reports indicate that a variety of training techniques have been used successfully to teach manual skills to severely and moderately retarded adults. Most of these procedures relied on some analysis of the task to identify small measurable components which provided the basis of the training and evaluation procedure. Gold (1972), for example, lists the visual discriminations required to assemble a bicycle brake, and records performance of trainees by noting correct and incorrect discriminations. Crosson (1967) analyzed his tasks into discriminated operants, thus emphasizing both the discriminations and movements required.

Different authors have emphasized various techniques for training correct performance after task steps are identified. These include reinforcement of successive approximations (Crosson, 1967), priming the response, or physically putting the trainee through the required movements (Williams, 1967), verbally instructing trainees to perform the desired response (Brown, Bellamy, Perlmutter, Sackowitz, & Sontag, 1971), modeling the correct movement (Clarke & Heremelin, 1955), providing additional cues to increase attending to relevant stimulus dimension (Gold, 1974) and changing the nature of discriminations to match the skill of trainees (Tate & Barhoff, 1967).

The training procedures used in this illustration represent a synthesis of those reported in earlier literature, with particular attention given to results of the few studies of relative efficiency of alternate training procedures (Gold & Barclay, 1973a, 1973b).

Method

Subjects (*Ss*)

Training data is presented in this illustration from two adult residents of a state institution for the retarded. S_1 is a 26-year-old Down's Syndrome male who has been institutionalized for the last 15 years. S_1 obtained a Vineland Social Quotient of 23 and an IQ of 10 on the Peabody Picture Vocabulary Test. He is nonverbal and was described in current institutional records as having a "withdrawn social attitude and a "severe deficit in adaptive behavior."

S_2 is a 22-year-old female diagnosed as manifesting retardation due to unknown causes. S_2 obtained a Vineland Social Quotient of 19 and was described within the past year as having "a bad temper" and a "tendency toward self-abusiveness" and was considered a runaway problem. S_2 has spent the last 19 years in this institution.

Work Task

Both *Ss* were taught to assemble the 19-piece cam switch actuator illustrated in Figure 1. Component parts ranged in size from ⅜″ in length and 3/16″ in diameter to 2¾″ in length and 1″ in diameter, and they were placed in bins arranged from left to right in order of use. Assembly required, in addition to the bins, a metal stabilizing post, two types of retaining ring tools, and tweezers. The entire task was divided into 51 steps, each of which involved both manipulation and discrimination components (see Table I). A step was considered correctly performed if absolutely no assistance from the trainer was required. That is, during a correct step the only information available to the subject was that provided by the task itself.

The task was divided into four segments for training. The first (steps 1-8) involved placing the first 8 components in front of the respective bins, and in the second segment (steps 9-27) these components were assembled. The remaining 11 components were placed in front of the respective bins during the third segment (steps 23-31); in the fourth these were assembled and attached to the previous assembly (steps 32-51).

Training Procedures

During training each segment was taught until *S* reached a criterion of two consecutive trials in which all steps were performed correctly. A trial involved performing each step in the segment being taught together with previous segments. *S* was seated in front of the task and was expected to perform each step in sequence without assistance of any kind. When a step was correctly performed, *S* received such presumed reinforcers as excited compliments, edibles

Table I

STEPS IN ASSEMBLY OF 19-PIECE CAM SWITCH ACTUATOR

Segment	Step	Manipulation	Necessary Discrimination
I	1.	Place AXLE in front of bin	Correct bin
	2.	Place CAM in front of bin	Correct bin
	3.	Place BEARING in front of bin	Correct bin
	4.	Place RING in front of bin	Correct bin
	5.	Place BEARING in front of bin	Correct bin
	6.	Place ROLLERS in front of bin	Correct bin
	7.	Place SPRING in front of bin	Correct bin
	8.	Place SPRING in front of bin	Correct bin
II	9.	Put AXLE on POST	Long end up
	10.	Put CAM on AXLE	Gears down
	11.	Put BEARING on AXLE	Holes down
	12.	Put RING in TOOL	Open side out
	13.	Put RING on AXLE	In axle rim
	14.	Put BEARING on table	Legs to right/short pole front
	15.	Pick up ROLLER	Lip to right
	16.	Put ROLLER in hole	Seated
	17.	Put SPRING in BEARING	In first slot/seated
	18.	Put BEARING in CAM	Seated
	19.	Put CAM on table	Silver pole right/roller hole up
	20.	Pick up ROLLER	Lip to right
	21.	Put ROLLER in hole	Seated
	22.	Put SPRING in BEARING	In first slot/seated
III	23.	Place AXLE in front of bin	Correct bin
	24.	Place BEARING in front of bin	Correct bin
	25.	Place RING in front of bin	Correct bin
	26.	Place GROUND in front of bin	Correct bin
	27.	Place GROUND in front of bin	Correct bin
	28.	Place CAM in front of bin	Correct bin
	29.	Place ROLLER in front of bin	Correct bin
	30.	Place SPRING in front of bin	Correct bin
	31.	Place SPRING in front of bin	Correct bin
IV	32.	Put AXLE on POST	Long end up
	33.	Put BEARING on AXLE	Seated
	34.	Put RING on AXLE	Over bearing lip
	35.	Squeeze and push RING w/TOOL	On lip
	36.	Push RING down	Until it snaps
	37.	Grasp GROUND with TWEEZERS	Bend down/wire perpendicular
	38.	Put GROUND in BEARING	Upper left hole
	39.	Turn BEARING	180° turn
	40.	Grasp GROUND with TWEEZERS	Bend down/wire perpendicular
	41.	Put GROUND in BEARING	Upper left hole
	42.	Put CAM in BEARING	Seated
	43.	Put CAM on table	Pole to left/roller hole up
	44.	Pick up ROLLER	Lip to right
	45.	Put ROLLER in hole	Seated
	46.	Put SPRING in BEARING	In first slot/seated
	47.	Turn CAM over	Roller hole up
	48.	Pick up ROLLER	Lip to right
	49.	Put ROLLER in hole	Seated
	50.	Put SPRING in BEARING	In first slot/seated
	51.	Put two CAMS together	Both silver poles up

and affectionate physical contact. Each incorrect step was followed immediately by a correction procedure in which the trainer provided assistance with a verbal direction, model or physical prime. *S* was then asked to repeat the step, and the process was repeated as many as three times if necessary for *S* to respond correctly. The specific correction used depended both on the kind of error and on the trainer's judgment concerning the least amount of assistance which could produce the correct responses. Verbal directions ranged from a non-specific, "Try again," to a definitive statement such as "The holes go up." Similarly models and primes ranged from non-specific gestures and touches to complete performances of the required movements. Corrections were gradually made less specific across trials until step was performed completely independently.

A simultaneous component of the training procedure involved increasing behaviors conducive to efficient assembly work while attempting to decrease incompatible behaviors. For example, the two *S*s emitted such behaviors as refusal to visually attend to the task, hitting and kicking the table, body rocking, smelling or mouthing component parts, and leaving the work area. That these behaviors occurred primarily during initial trials provides some support for the use of frequent reinforcement for appropriate behavior and brief withdrawal of trainer attention following inappropriate behavior.

Results

S_1 reached the criterion of two consecutive perfect trials for the four segments in 12, 43, 2 and 32 teaching trials, respectively (See Figure 2). The criterion of two consecutive perfect assemblies of the entire task was attained after 89 trials in 8 hours and 38 minutes of actual training. Steps 21, 35, and 36 required the most trials before consistently correct performance.

S_2 reached the criterion performance for the four segments in 8, 10, 3, and 18 trials, respectively (See Figure 2). Criterion performance for the entire assembly was met in 40 trials in 6 hours and 19 minutes of actual training. Steps 15 and 13 required the most training trials before correct performance.

An apparently complex assembly task thus was learned by two long-term institution residents who had not participated in previous vocational programming. These results support the suggestions of Crosson (1967) and Gold (1974) that severely and profoundly retarded adults can learn a variety of precise movements and discriminations in relatively brief training periods. Further, the present results strongly suggest that typical expectations regarding the vocational abilities of this group need reevaluation. Obviously, however, the acquisition of such vocational skills has considerably more practical importance if subsequent productivity is sufficient for remunerative employment. This is the focus of the final illustration.

Production Rate

A growing body of literature suggests that rather immediate environmental events can account for considerable inter- and intra-individual variability in productivity of retarded workers in sheltered employment. Much of the research follows an interest in applying principles of operant behavior to sheltered workshop operation (Linde, 1962; Crosson, 1969) and it suggests the utility of attributing some performance deficits to characteristics of the work

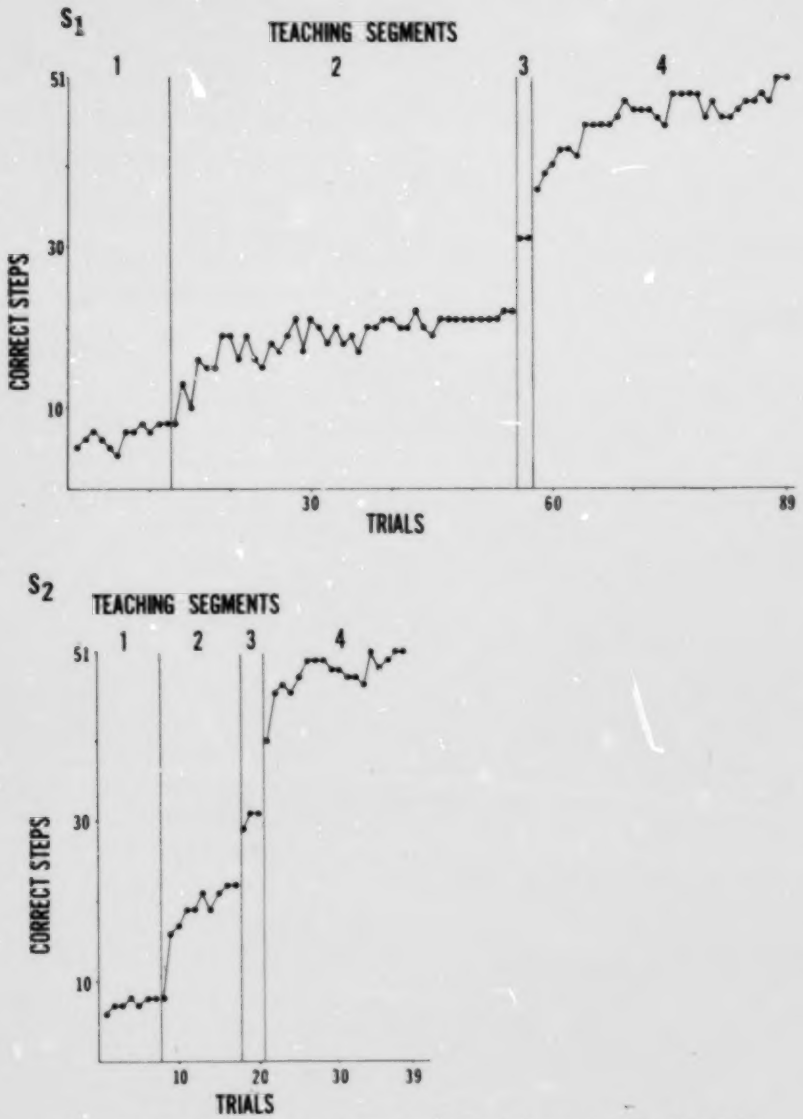

FIGURE 2. Number of steps performed correctly during each phase of teaching.

setting rather than to measured disabilities of the worker. The research indicates that work rates may be improved with environmental changes such as (1) providing presumed reinforcing consequences for work (Bellamy & Sontag, 1973; Brown, Johnson, Gadberry, & Fenrick, 1971; Brown, Van Deventer, Perlmutter, Jones, & Sontag, 1971; Huddle, 1967; Jens & Shores, 1969; Schroeder, 1972; Trybus & Lacks, 1972; Zimmerman, Stuckey, Garlick, & Miller, 1969); (2) providing presumed aversive consequences for lower rates (Greene & Hoats, 1969; Zimmerman, Overpeck, Eisenberg, & Garlick, 1969); (3) giving definitive instructions about expected performances

or consequences (Allyon & Azrin, 1964; Evans & Spradlin, 1966; Gordon, O'Connor, & Tizard, 1955; Headrick, 1963; Kliebhahn, 1967); and (4) arranging for work with a more competent coworker (Brown & Pearce, 1970; Kliebhahn, 1967).

Although a few work performance studies have dealt specifically with the severely retarded (Crosson, 1967; Karen, Eisner, & Endres, 1974), practical techniques for improving productivity have not been extensively investigated with this group. Thus, one of our efforts to develop functional techniques for increasing work rates in an applied vocational setting is illustrated in this section.

Method

Subject (S_3)

The employee whose production records are presented here is a 21-year-old male diagnosed as severely retarded on the basis of both the Vineland Social Maturity Scale and the Stanford-Binet. He had attended school less than one year and had resided in a state institution for five years prior to inclusion in the Specialized Training Program. Data reported here were collected eight months after *S* entered the program.

Work Task

The task completed by S_3 involved complete assembly of a 52-piece cam switch actuator subcontracted from Tektronix, Inc., and illustrated in Figure 1. Industry-established time standard for the task is 20 minutes, and this standard provides the basis for both the subcontract arrangement and the productivity measures reported here. During production the task components were arranged in bins like those described by Gold (1972). Assembly required the use of needlenose pliers, tweezers, a calibrated phillips screwdriver, and a container of silicone grease.

Procedure

S_3 was taught to assemble the actuator two months prior to collection of the data reported here, using procedures like those described above. All production work was done in a single large room equipped with several tables which served as individual work areas. Three to seven other workers and one supervisor were typically in the production area, although it was not uncommon for a second supervisor (university practicum student) also to be present. The production data reported here was collected during 5 months on the 31 work days when this task was available. Baseline measures of S_3's production rate were obtained under normal supervision conditions. Although the specific amount of attention which S_3 received during this phase was not recorded, S_3 was consistently praised by the supervisor at the completion of each product and frequently received some attention during the task cycle.

Two treatments were then introduced during the morning and afternoon work periods with counter-balanced presentation as described by Browning (1967). In one of these, the supervisor was instructed to praise S_3 an average of every 2 minutes for engaging in behaviors specifically required for task completion. In the other treatment the supervisor was instructed to remind S_3 to return to work any time S_3 was observed engaging in off-task behaviors. The actual frequency of praises and reminders provided during these treatments is unknown.

During the reversal phase, supervisors were instructed to again provide normal supervision, with S_3 receiving praise and attention at least after each product was completed.

During the second treatment, supervisors were instructed to provide either praise for work or reminders to return to work at an average of every two minutes, and were also instructed to record the frequency of these comments. According to this record, supervisor comments ranged from an average of one every 1.4 minutes to one every 5.8 minutes during the fourth treatment phase.

Results and Discussion

Production data is reported here as a percent of normal productivity, computed by dividing the normal time standard by the average daily time required to assemble the actuator. Thus 100% normal production rate for a day indicates that S_3 required an average of 20 minutes per unit, while 50% normal production denotes an average of 40 minutes per unit.

During baseline, S_3 averaged 56.2 percent of normal production, ranging from 48 to 100 percent. This increased to an average of 94.6 percent in the praise treatment, ranging from 77 to 100 percent, and averaged 102.5 percent in the reminder treatment, ranging from 74 to 133 percent. Productivity decreased to an average of 59.5 percent during the reversal (range 44 to 67 percent). In the final treatment, S_3 averaged 101.1 percent normal productivity and ranged from 72 to 122 percent (See Figure 3). Supervisors' comments which either commend or correct performance thus appear to be functionally related to productivity of this employee. As supervisors were instructed to increase the frequency of contact with the subject, his work rate increased to the normal range.

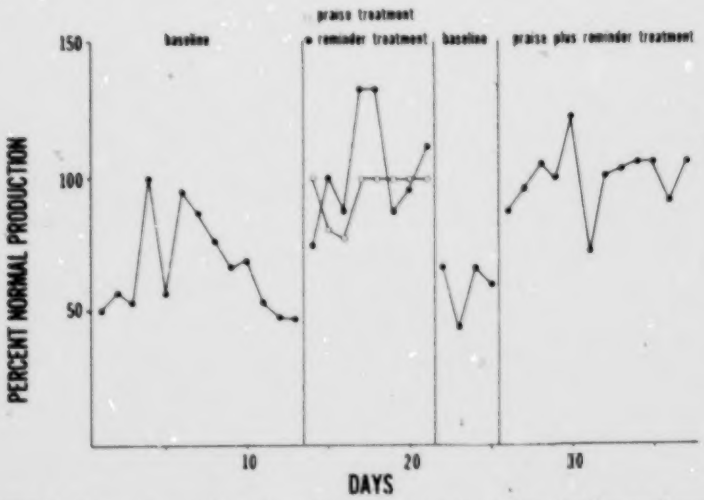

FIGURE 3. Percent normal productivity attained by S_3 during baseline and treatment conditions.

An additional result of note concerns S_3's average level of earnings rather than his performance on a single task. Workdays in the Specialized Training Program during the past six months have ranged from four to five hours with an approximate monthly total of 100 hours. S_3's monthly earnings (piece rates) during these six months have ranged from $76.86 to $131.46 with a monthly average of $99.69 and an hourly average of approximately one dollar.

Discussion

The illustrations presented in this paper and the earlier research from which they derive indicate that vocational habilitation is a feasible goal for severely and profoundly retarded adults. Remunerative work tasks are available. Effective training techniques have been identified. Productivity can be maintained within normal ranges. Thus Lindsley's (1964) suggestion that retarded behavior may result less from a deficit in the labeled individual than to a deficit in environmental design appears applicable to vocational settings. It may be possible to design work environments which develop and maintain non-retarded work behaviors in individuals labeled severely and profoundly retarded.

If this is to be accomplished, however, considerably more research is needed to identify person, task, and setting variables which may affect habilitation outcomes and to evaluate the economic feasibility of various approaches to training and supervision. More specifically, research is needed to determine the extent to which the training and production successes illustrated here can be generalized to other tasks. What quantifiable task characteristics affect acquisition and production rates? Data is available indicating that the kinds of discriminations required by a task can affect learning rate (Zeaman & House, 1963), and there is speculation that task characteristics such as novelty or complexity can affect productivity (Gold, 1973; Tate & Barhoff, 1967; Kahn & Burdett, 1967). However, research has not yet provided an empirical basis for task selection in workshops for the severely retarded.

Research is also needed to identify factors which account for variability in time and expense for vocational training. This should include comparisons of various components of teaching procedures, as in the work of Gold and Barclay (1973a; 1973b) and also identification of personological variables which correlate with training time. A research program currently underway in the Specialized Training Program addresses the latter issue.

Finally, additional work is needed to develop comprehensive evaluation methods for both workshop programs and individual habilitation outcomes. This could include, for example, the development of reliable simultaneous measures of vocational, personal and social behaviors which are maintained in the work setting.

Active investigation of these and similar applied research issues may provide a basis for the development of effective vocational programs for severely and profoundly retarded adults. The possible vocational competencies of these individuals have been documented here and in previous work by Clarke and Heremelin (1955), Williams (1967), and Crosson (1967), but wider utilization of the approach suggested in this work will require continued experimental analysis of applied vocational settings.

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VOCATIONAL TRAINING

General Utility of Easy-to-Hard Discrimination Training Procedures

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Abstract

The general utility of a method of teaching difficult visual discriminations in assembly tasks to severely retarded persons was investigated. Twenty-four severely retarded adults were trained to assemble a bicycle axle and nut. Correct positioning of the nut required a difficult visual discrimination. The training procedure involved teaching a series of "easier" discriminations between the faces of lock-nuts to facilitate acquisition of the criterion discrimination. Results suggested that though this easy-to-hard training procedure facilitated criterion performance by 17 of 24 subjects, its general applicability appeared limited.

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General Utility of Easy-to-Hard Discrimination Training Procedures

Successful vocational skill training and subsequent remunerative employment are now considered possible for severely retarded persons (Bellamy, et al., 1975; Crosson, 1969; Gold, 1972; Gold & Barclay, 1973). This has resulted primarily from systematic application of information from basic learning theory and research to settings where practical skill training occurs.

The purpose of the current study was to investigate the general utility of a method of teaching difficult visual discriminations in assembly tasks to severely retarded persons. Because most assembly tasks require discrimination skills, an obstacle is commonly encountered in such training of severely retarded persons. They consistently exhibit an apparent reduced ability to select and attend to the relevant dimension(s) in discrimination tasks. Fisher and Zeaman (1973), and Zeaman and House (1963) and others have formulated and empirically tested an "Attention Theory" that satisfactorily explains this discrimination learning characteristic of retarded people. Gold and Scott (1971) describe the practical implications of Attention Theory for application in training settings.

A training procedure related to Attention Theory involves teaching an easy discrimination to facilitate the later learning of a difficult discrimination on the same relevant stimulus dimension. There is striking consensus of findings that the procedure—adding and reducing large cue differences on the relevant dimension (ARLCD)—facilitates difficult visual discrimination learning by retarded, non-retarded and infra-human subjects alike (Baker & Osgood, 1954; Gold & Barclay, 1973; House & Zeaman, 1960; Lawrence, 1952; Shepp & Zeaman, 1966). None, however, result from studies employing assembly tasks. In fact, with respect to vocational training of severely retarded individuals, only Gold and Barclay (1973) have examined the effects of ARLCD training outside experimental laboratory contexts, and their task involved sorting bolts of different lengths. The current study was designed to systematically investigate the utility of ARLCD procedures for teaching a difficult visual discrimination in an assembly task to severely retarded individuals.

Method

Design

Only one treatment group was used in the study. Every previous examination of the effects of the ARLCD procedures demonstrated that they succeed in producing criterion learning of a difficult visual discrimination by moderately and severely retarded people while traditional differential reinforcement techniques fail. The difficulty of the task was established with ten severely retarded pilot subjects; none acquired the criterion discrimination by 200 trials via traditional differential reinforcement training. The independent variable was ARLCD training, and the dependent variables were trials and errors to criterion at each of four phases of training.

Subjects

Twenty-four adults were randomly selected from a population of approximately 150 severely retarded residents of a state hospital in the Northwest on the basis of institution classification records. The mean measured IQ/SQ for the sample was 25.6, with a range of 15 to 39. Chronological ages ranged from 16 to 43.

Materials

The apparatus consisted of a small plywood tray with two compartments open on the front and separated by a space in the middle. The materials for the criterion task were 10⅜ inch diameter Phillips bicycle front axle nuts and 10¼ inch diameter bicycle posts. One face of the axle nuts was flat and the other was slightly raised (.10 cm.). The training materials consisted of 10 each of three different Flex-Lock lock nuts and 10 bicycle axle posts. The Flex-Lock lock nuts were chosen as training materials because they presented varying degrees of exaggerated cues on the relevant shape of face of nut dimension. Lock nuts with one face raised .45 cm. were used in the first phase of training; those with one face raised .30 cm. and .20 cm. were used in the second and third phases respectively. The materials for the criterion task were used in the fourth and final phase of training.

Procedures

Participants were trained individually while seated at a table. Other residents were often working and receiving training in the same room. At the beginning of the initial training session, modeling and full physical prompts were used to teach subjects the required sequence of movements: reach with left hand into left compartment, grasp one axle nut with thumb and index finger of left hand, withdraw axle nut from compartment, look at axle nut and rotate it with right thumb and index finger, reach with right hand into right compartment, grasp one axle post with right hand, insert axle post into axle nut, place completed assembly into space between compartments. No data were collected and no teaching of the criterion discrimination occurred during this familiarization period.

Once participants correctly performed the required movements, training of the criterion discrimination began. The experimenter modeled the entire task again and asked the subject to "do the rest." Measures of discrimination were taken at the point that the subject evidenced satisfaction with the position of the axle nut in the left hand by reaching for an axle post with the right hand. For every discrimination error, a correction procedure was instituted. Preventing the subject from grasping an axle post, the experimenter provided verbal cues ("No" or "Turn it over") or full or faded physical prompts to teach the subject the correct positioning of the nut. Only one measure per trial was taken; subject's responses to corrections were not scored. After every correct discrimination or completed trial, the experimenter said, "Good," "Excellent," "Yes," etc., and patted the subject on the back or arms.

In the first of four training phases, subjects were required to learn a discrimination between the two faces of Flex-Lock nuts that had one face raised .45 cm. and one flat face. Each successive phase required a more difficult discrimination between the faces of lock nuts with one face progressively less raised. The Phillips bicycle axle nuts with one face raised .10 cm. were used in the final phase of training. Twenty consecutive correct discriminations constituted criterion at each phase.

Subjects who failed to learn the criterion discrimination within 700 trials were not trained further because it was believed that they would not acquire the discrimination without a change in training procedures.

Results

Seventeen of the 24 subjects learned the criterion discrimination within 700 trials. Mean trials to criterion was 208.8 with a range of 86-372, and mean errors was 34.0 with a range of 2-11, not including data from the seven subjects who did not achieve criterion.

Table 1 presents the means and standard deviations of trials and errors to criterion at each phase of training. As is evident, inter-subject variability was high. The trials and errors data were analyzed using two separate single-factor Analyses of Variance with repeated measures (phases of training) to examine the power of the ARLCD technique, that is, to assess the extent to which trials and errors decreased across training phases. Overall differences were present between trials and errors, respectively, at different phases of training ($F_{errors} = 4.7$, $p<.01$, $df = 3,48$; $F_{trials} = 2.81$, $p<.05$, $df = 3,48$).

Table 1

Means and Variability of Trials and Errors to Criterion

	Phase 1	Phase 2	Phase 3	Phase 4	Total
Trials	73.50	36.50	46.30	52.60	208.80
S.D. Trials	63.99	23.87	30.92	35.66	98.66
Errors	19.20	3.20	4.70	6.90	34.00
S.D. Errors	26.27	4.68	6.62	6.43	32.39

Table 2 presents the results of Scheffe Multiple Means Comparisons of trials and errors, respectively, at different phases of training. These comparisons revealed that significant differences existed between trials and errors at phase one of training and trials and errors, respectively, at all other phases, with the exception of trials at phases one and four. No other differences existed between trials and errors, respectively, at phases 2, 3, and 4.

Table 2

Multiple Means Comparisons of Trials and Errors At All Phases of Training

	Trials			Errors		
	Phase 2	Phase 3	Phase 4	Phase 2	Phase 3	Phase 4
Phase 1	7.86*	4.24*	N.S.	11.00*	9.07*	6.44*
Phase 2		N.S.	N.S.		N.S.	N.S.
Phase 3			N.S.			N.S.

* $p < .01$, 3/48 df

Discussion

The results can be interpreted in two ways. First, the obvious interpretation is that ARLCD procedures can be helpful for teaching a difficult visual discrimination involved in an assembly task to institutionalized severely retarded persons. This is noteworthy in that previous investigations with similar results occurred in laboratory settings and/or focused on the effects of ARLCD training with mildly or moderately retarded individuals (Gold & Barclay, 1973; House & Zeaman, 1960; Shepp & Zeaman, 1966; Switzky, 1973). If it is important to establish whether ARLCD procedures can be implemented for training severely retarded individuals to complete assembly tasks in workshop settings, these results can be interpreted as providing affirmative evidence. Where every expectation would be that traditional discrimination training would fail to produce criterion acquisition (Gold & Barclay, 1973; House & Zeaman, 1960; Shepp & Zeaman, 1966), 17 of 24 subjects achieved criterion via ARLCD training. The training phase mean trials and errors to criterion and multiple means comparisons in Tables 1 and 2, respectively, demonstrate that once the phase 1 "easy" discrimination was acquired, trials and particularly errors were substantially and significantly minimized during the remainder of training; the learning of an "easy" discrimination appeared to facilitate the later acquisition of a more difficult discrimination on the same dimension involved in an assembly task.

Certain crucial questions, however, remain to be asked and answered. How effective can ARLCD procedures be expected to be when used with retarded persons in practical vocational training settings? What governs their utility in those settings? When examined in the light of these questions, data from the current and other similar studies (for example, Gold & Barclay, 1973) can be interpreted as leading to a second, less obvious, conclusion: though ARLCD procedures can be effective, their general utility appears limited for application(s) to vocational training of severely retarded persons in practical settings.

Table 1 illustrates that though ARLCD training effected criterion discrimination acquisition by 17 of the 24 subjects, mean trials and errors to criterion were numerous (trials range 86-372, errors range 2-100) and inter-subject variability was high. Trials and errors to phase 1 criterion were particularly numerous (trials range 20-239, errors range 0-89), with wide variability on both measures. In addition, seven of the 24 subjects did not achieve criterion acquisition. Gold & Barclay's (1973) results were similar; mean trials to criterion for a group trained to make a difficult visual discrimination via ARLCD procedures was 394 with a range of 200-750. The implications of high inter-subject variability and numbers of trials and errors required to reach criterion are important in any assessment of the general utility of a training technique, particularly for those techniques to be used with retarded persons. Gold and Barclay (1973), Sidman (1967), Zeaman and House (1963) and others (Bialer & Cromwell, 1965; Gardner, 1966) note the possibly debilitating effects of errors on retarded learners. Touchette (1968) maintains that trial and error learning interferes with discrimination acquisition. The results of the current study (and those of the Gold and Barclay (1973) study) can be interpreted to suggest that trial and error learning occurred throughout a substantial portion of phase 1 of training and interfered with acquisition of the criterion discrimination.

The ineffectiveness of ARLCD training in this study appears to derive from the lack of immediate establishment of stimulus control in phase 1 of training, a factor that Sidman and Stoddard (1967), Terrace (1966) and Touchette

(1968) emphasize as important for effective training strategies. The materials for ARLCD training in this study were purposefully restricted to assembly-type objects that could be readily and inexpensively obtained. The rationale was that a training strategy can be useful in a practical setting only if its components are relatively accessible and easy to implement. Stimulus control could have been more readily established in phase 1 had larger differences existed between cues on the relevant dimension of the training stimuli.

The problem for this study was that training stimuli with sufficiently large cue differences were not readily available. It is this factor—unavailability of appropriate training stimuli—that would seem to render ARLCD ineffective in many practical settings. Stimuli with sufficiently exaggerated cues on the relevant dimension will often be difficult, time-consuming or expensive to locate. Only some tasks in practical settings, then, appear to lend themselves to ARLCD procedures. Gold and Barclay's (1973) bolt-sorting task and the bicycle axle nut discrimination in the current study appear, at first glance, to be examples. The data from these studies, however, demonstrate that even with such tasks, determining whether sufficiently exaggerated cues exist on training stimuli is an empirical problem and difficult at best.

Though ARLCD procedures may not be optimally effective for teaching many assembly tasks to severely retarded persons, it should not be inferred that their use is ruled out entirely. Where appropriately and sufficiently exaggerated training stimuli are available, their use should be considered. The results of the current and other studies, though, suggest that that may not often be the case because trainers' perceptions of what constitutes "sufficiently exaggerated" may not be accurate. ARLCD procedures appear to be an example of a technique derived from learning theory and research that may not have wide applicability in vocational training settings that involve teaching bench assembly skills and tasks to severely retarded persons.

Continued applied research that assesses the *relative* efficacy of various training procedures for teaching assembly tasks will be most useful. Current studies by the author and colleagues aim to compare the effectiveness of match-to-sample, color coding and fading, and ARLCD training techniques across a variety of assembly tasks that share various characteristics.

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Manipulation of Stimulus Features in Vocational Skill Training of the Severely Retarded: Relative Efficacy

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Abstract

Fifty-one severely retarded adults were taught a difficult visual discrimination in an assembly task by one of three training techniques. The efficacy of two previously reported techniques and a new combination of these techniques was compared. These were: (1) adding and reducing large cue differences on the relevant shape dimension (ARLCD); (2) adding and fading a redundant color dimension (AFRD); and (3) a combined ARLCD/AFRD procedure. Significant differences between techniques in both trials and errors before criterion performance were attributed to differences in the establishment of stimulus control in the first phase of training, with ARLCD/AFRD being the most efficient, AFRD next, and ARLCD the least efficient. These results demonstrated the effectiveness of the combined procedure and indicated that substantial differences may exist in the efficacy of various training procedures involving manipulation of stimulus features.

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Manipulation of Stimulus Features in Vocational Skill Training of the Severely Retarded: Relative Efficacy

Vocational training research with the retarded has focused historically on various reinforcement variables that facilitate production, and on predictive assessment and evaluation rather than on skill acquisition (Gold, 1972). In recent years, though, the role of stimulus factors in skill acquisition training has been systematically investigated (Gold, 1972, 1974; Gold & Barclay, 1973). Typically, however, such studies have not focused specifically on the severely retarded and have not examined relative effects of different stimulus factors. The present study was designed to examine the relative power of various stimulus-related variables for vocational skill training of the severely retarded.

The facilitative effects of manipulation of stimulus features in producing discrimination acquisition by severely retarded persons have been widely documented. Two procedures, in particular, have demonstrated remarkable utility in contrast to the ineffectiveness of traditional techniques involving differential reinforcement for approach to S+ and S— cues on relevant dimensions. One approach derives directly from the attention theory of Zeaman and House (1963) and related investigations which demonstrate that retarded individuals do not "attend to" or perceive as relevant the relevant dimension(s) in a discrimination task as readily as do non-retarded persons (Eimas, 1964, 1965; Fisher & Zeaman, 1973; Shepp, et al., 1972; Shepp & Zeaman, 1966; and Zeaman & Denegre, 1967). This first approach involves adding and gradually reducing or fading large differences between S+ and S— cues on the relevant dimension of a discrimination in order to facilitate discrimination acquisition. Essentially, an "easy" discrimination is taught initially to enhance later learning of a more difficult one on the same stimulus dimension. Disparity between cues on a dimension appears to increase the probability that that dimension will be attended to; research results consistently demonstrate that addition and reduction of large cue differences (ARLCD) facilities discrimination acquisition by the severely retarded (House & Zeaman, 1960; Shepp & Zeaman, 1966; Switzky, 1973). These effects have also been demonstrated in vocational skill training settings (Gold & Barclay, 1973).

A second stimulus factor manipulation approach, also derived in part from attention theory, involves increasing the number of relevant dimensions in discrimination tasks. When more than one relevant dimension exists, redundancy is said to occur. Retarded persons (and everyone else) have less difficulty performing discriminations correctly when redundant information is provided (Zeaman & House, 1963). Research results support the notion that increases in the number of relevant dimensions increase the probability that at least one will be attended to on any single trial (Fisher & Zeaman, 1973); invariably, as the number of redundant dimensions is increased, discrimination acquisition by retarded subjects is better facilitated (Bricker, et al., 1969; Brown, 1970; Eimas, 1964, 1965, 1969; Ullman & Routh, 1971; Zeaman & Denegre, 1967). The utility of this procedure has also been demonstrated in vocational skill training settings with the moderately and severely retarded (Gold, 1972).

An extension of this second strategy is based on techniques from operant literature and involves the fading or gradual progressive reduction across trials of redundant dimensions after an initial discrimination is acquired in the presence of redundant dimensions. Fading procedures are based on the notion that high saliency redundant dimensions can be superimposed on relevant dimensions of stimuli to establish immediate stimulus control over discrimination responding. Then, when these superimposed redundant dimensions are gradually eliminated, relevant dimensions more easily acquire stimulus control (Terrace, 1963, 1966). It has been convincingly demonstrated that such adding and fading of redundant dimensions (AFRD) facilitates difficult visual discrimination acquisition by severely retarded individuals (Sidman & Stoddard, 1967; Touchette, 1968, 1969).

A third approach, though not yet tested, is also possible. When examined in the light of attention theory and related research, findings by Schusterman (1967) and Martin (1969) and the voluminous fading literature (Moore & Goldiamond, 1964; Sidman & Stoddard, 1967; Terrace, 1963; and Touchette, 1968, for example) suggest that a procedure that combines ARLCD and AFRD strategies in a certain way may be more powerful than either individually for teaching difficult visual discriminations to the severely retarded. Discrimination learning may be most facilitated when high saliency redundant dimensions *and* large cue differences on relevant dimensions are initially present simultaneously. Salience is determined simply by learner preference or previous experience with a dimension, and redundant dimensions are chosen for their salience.

With AFRD procedures, as cues on high saliency redundant dimensions are faded, learners appear to become oriented to the nature of the task and "look around" for other dimensions on which to base discrimination decisions (Schusterman, 1967; Martin, 1969). In a combined ARLCD/AFRD approach, great disparity between S+ and S− cues on a low saliency relevant dimension can be maintained while high salience redundancies are faded. As a result, the probabilities would appear to be increased that attention will begin to focus on that relevant dimension. This appears especially likely for severely retarded individuals because of their reduced ability to attend to relevant dimensions. Initial use of a high salience redundant dimension such as color can be expected to establish immediate stimulus dimension control. For discussions of the salience of color for retarded individuals, see Bond, et al. (1973), Goesling (1973), Klein, et al. (1972), and Schaie (1968). As much redundant dimensions are faded, remaining large cue differences on low saliency relevant dimensions can serve to highlight and acquire stimulus control for those relevant dimensions. Those cue differences can then be decreased across trials as in a standard ARLCD approach.

The effects of such a combined ARLCD/AFRD procedure have not been experimentally investigated in or outside of vocational skill training settings for the severely retarded. In addition, the relative efficacy of ARLCD, AFRD and ARLCD/AFRD procedures had not been examined. The necessity for investigating both of these issues derives primarily from two consistent results of previous studies of vocational skill acquisition by the retarded: though ARLCD and AFRD procedures effect discrimination acquisition by retarded individuals where traditional differential reinforcement techniques fail, large numbers of training trials and considerable variability often accompany such results (Gold, 1972, 1974; Gold & Barclay, 1973). The combined ARLCD/AFRD procedures employed in this study were devised to minimize training trials and variability.

The general purpose of the study, then, was to contribute to the development of a methodology for teaching severely retarded individuals the discrimination skills required by assembly tasks commonly encountered in vocational training settings. Specifically, two issues were examined: (1) the effects of combined ARLCD/AFRD training on the acquisition of a difficult visual discrimination in an assembly task by severely retarded individuals; and (2) the relative efficacy of ARLCD, AFRD and combined ARLCD/AFRD training procedures. Though these questions are experimental, any findings have important implications for application to vocational skill training settings.

Method

Design

The relative efficacy of three training procedures was compared: (1) adding and reducing large cue differences on the relevant shape dimension (ARLCD); (2) adding and fading a redundant color dimension (AFRD); and (3) a combined ARLCD/AFRD procedure. Table 1 describes the three training procedures. No control or differential reinforcement condition was included, since previous research overwhelmingly indicated that any individual attention engineering strategy was more effective than differential reinforcement only.

Table 1

TREATMENT CONDITIONS

Phase	Group I ARLCD	Group II AFRD	Group III Combined ARLCD/AFRD
1	Large cue differences on the relevant shape dimension	High color intensity on slightly raised face of test stimuli	High color intensity and large cue differences on the relevant shape dimension
2	Medium cue differences on the relevant dimension	Medium color intensity on slightly raised face of test stimuli	Low color intensity and medium cue differences on the relevant shape dimension
3	Small cue differences on the relevant shape dimension	Low color intensity on slightly raised face of test stimuli	Very low color intensity and small cue differences on the relevant shape dimension
4	Criterion test stimuli—very small difference between cues on the relevant dimension	Criterion test stimuli—no redundant color cues and very small differences between cues on the relevant dimension	Criterion test stimuli—no redundant cues and very small differences between cues on the relevant dimension

Subjects

Half of the population of the Fairview Hospital and Training Center that met the following criteria were randomly selected as the subject pool for this study: IQ/SQ in the range 15-40; no vision deficits or crippling conditions that would impair performance; age 16 years or above. These 102 individuals were randomly assigned to three treatment groups, 34 to each. Table 2 presents subject data obtained from the hospital records.

Table 2

MEANS AND RANGES OF CHRONOLOGICAL AGES AND INTELLIGENCE QUOTIENTS OF SUBJECTS

Group	*	IQ/SQ Range	IQ/SQ Mean	N	C.A. Range	C.A. Mean (years)
ARLCD	A	17-36	28.4	8	20-28	23.6
	B	16-39	26.7	17	16-43	25.3
	C	15-30	21.8	7	16-25	21.3
AFRD	A	22-36	29.4	9	19-36	26.2
	B	15-39	26.7	17	16-45	25.5
	C	20-29	23.0	4	16-28	23.2
Combined ARLCD/ AFRD	A	16-35	24.5	7	16-39	26.6
	B	16-30	23.1	17	16-38	24.6
	C	20-23	21.0	3	18-23	20.6

*A—Pretested Out
B—Required Training, Reached Criterion
C—Required Training, Did Not Reach Criterion

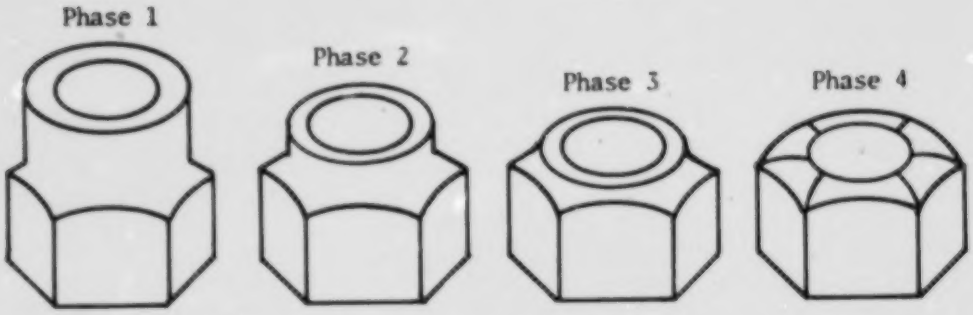
Because some subject loss was expected, subjects were randomly ordered from 1 to 34 and received training in the assigned order. Two subjects in each condition exhibited severe behavior problems and were eliminated from the study. One subject was dropped because of hospitalization and another died before training was begun. A total of 24 subjects reached criterion during a pretest and were not included in the training program. The possibility that some subjects would not reach criterion in 700 trials was also recognized at the outset, and it was predetermined that training of subjects would continue in the assigned order until 17 reached criterion in each condition.

Materials

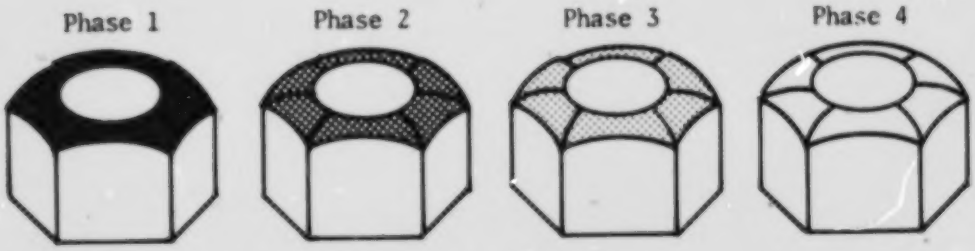
The materials for the criterion task were 10 ⅜-inch diameter Phillips bicycle front axle nuts and 10 ¼-inch diameter, 2-inch long Round Head Machine Screws comparable to bicycle axle posts. One face of the axle nuts was flat and the other was raised .10 cm. Different training materials were used in each of the three conditions, and these are illustrated in Figure 1.

The training materials for ARLCD training consisted of 10 each of 3 different ⅜-inch Flex-Lock nuts and 10 of the Round Head Machine Screws; lock nuts with one face raised .45 cm., .30 cm., and .20 cm. were used in the first three phases of training respectively. Large initial differences on the relevant shape of face of nut dimension were thus gradually removed. The materials for the criterion task were used in the fourth and final phase of training.

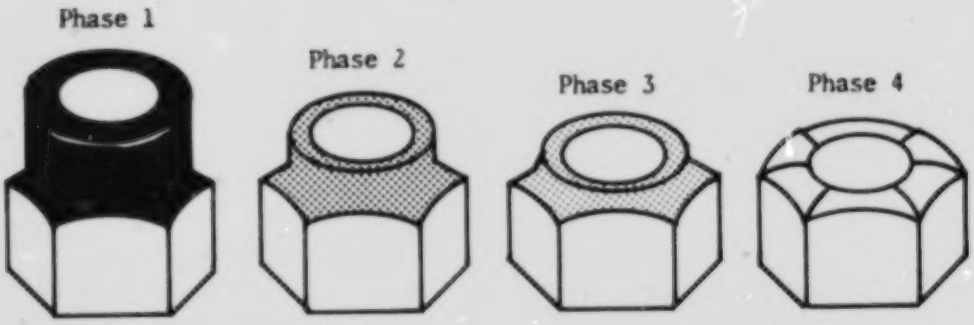
The training materials for AFRD training consisted of the materials for the criterion task with varying intensity of red coloring applied to the slightly raised face of the nuts. For the first phase of AFRD training, one part clear substance and five parts coloring substance were applied to the slightly raised face of 10 criterion task axle nuts. A redundant color cue was thus present and of quite high intensity. During the second and third phases of AFRD Training, the intensity of the color cue applied to the materials was reduced by first mixing 20 parts clear with one part color and then 60 parts clear with one part color. Ten criterion task axle nuts without any color cues were used in the final phase of AFRD training. The various ratios of clear to color substances



Condition I - Adding and Reducing Large Cue Differences (ARLCD)



Condition II - Adding and Fading Redundant Dimensions (AFRD)



Condition III - Combined ARLCD/AFRD

Figure 1
MATERIALS/DISCRIMINATIVE STIMULI

were determined by the experimenter's subjective perceptions of noticeable color intensity changes.

The training materials for the combined ARLCD/AFRD training consisted of the materials for the ARLCD condition with varying ratios of coloring and clear substances applied to the raised faces of the Flex-Lock lock nuts. Ten ⅜-inch diameter lock nuts with one face raised .45 cm. and with one part clear and five parts color applied to the raised face were used for the first phase of ARLCD/AFRD training. As in the ARLCD condition, lock nuts with faces raised .30 and .20 cm. respectively were used in the second and third phases of ARLCD/AFRD. The intensity of the color cue was also reduced, with one part color and 60 parts clear used in the second phase and one part color and 120 parts clear in the third phase. As in other training conditions, the criterion task materials were used in the final phase of training. The large decrease in color intensity between phases one and two, while cue differences remained fairly large on the relevant shape of face dimension, is different from the corresponding decrease in AFRD training. It is based on the rationale for combined ARLCD/AFRD training discussed earlier.

Apparatus

The materials were placed in an apparatus consisting of two small three-sided compartments mounted on a 37.6 cm. x 14.8 cm. x 6.9 cm. plywood tray. The compartment to the subject's left contained the Phillips axle nuts or Flex-Lock lock nuts, and the compartment to the subject's right contained the Round Head Machine Screws. Completed units were placed in a space between the two bins.

Experimenters

The senior author and two undergraduate work-study students who had no previous experience with the severely retarded served as experimenters. The student experimenters received five full-day training sessions in which the training and data collection procedures were illustrated and practiced with six severely retarded individuals not included in the experiment. The author watched closely, provided instruction, answered questions, and allowed much practice.

Inter-experimenter reliability was established prior to and twice weekly during the experiment. After experimenter training, no disagreements in scoring occurred between experimenters. This was not particularly surprising because the basis for measurement was well established and defined: the position of the nut in the left hand at the time the subject first reached for a bolt with the right hand.

Procedures

Subjects were trained individually while seated at a table facing the apparatus. Training sessions lasted approximately 50 minutes and occurred twice weekly, with intervals between sessions of 2 to 4 days.

Completion of the task required the following sequence of movements: (1) Reach into the left compartment with the left hand, grasp one axle nut with thumb and index finger, and withdraw it from the apparatus. (2) Look at the axle nut and rotate it with the right thumb and index finger until the raised side faced up. (3) Reach with the right hand in the right compartment, grasp one axle post and insert it into the flat side of the axle nut. (4) Place completed

assembly into the space between the compartments. The discrimination of interest was the final position of the axle nut in the left hand. All responses were categorized as correct or incorrect, all data recorded, and all correction procedures implemented as soon as a subject evidenced satisfaction with the position of the nut by reaching for the axle post.

Familiarization

The beginning of the initial training session was used to familiarize each subject with the materials, apparatus and task movements. The experimenter modeled the entire sequence of movements and provided verbal directions or physical assistance as needed for the subject to perform them. The familiarization period continued until the subject could complete the entire sequence of movements independently. During familiarization no data were collected and no teaching of the criterion discrimination occurred. All subjects learned the necessary movements within two sessions, and most learned them within the first 10 or 15 minutes of the first session.

Once the subject correctly performed the movements required by the task, pretesting began. Pretesting consisted of attempting to train the subject to perform the criterion discrimination via differential reinforcement alone during 50 trials.

Pretesting began with the experimenter demonstrating the whole procedure again with the criterion task stimuli exactly as was done for familiarization. After this demonstration, the experimenter pointed to the left compartment and asked the subject to "do the rest".

A correction procedure followed each discrimination error. When the subject reached for a bolt with the nut incorrectly positioned in the left hand, the experimenter prevented the subject from grasping a bolt, pointed to the nut and said, "No, turn it over". If the subject then correctly positioned the nut, the experimenter said, "Good. The raised side goes out", and pointed to the bolts to encourage the subject to complete the assembly. If the subject did nothing or reached again for a bolt in response to the experimenter's correction, the experimenter fully physically primed the subject's right thumb and index finger to correctly position the nut in the left hand. The experimenter then said, "Good. The raised side goes out", and pointed to the bolts to encourage completion of the assembly.

Several apparent reinforcers were used in training. After every correct discrimination by the subject, the experimenter said, "Good", "Excellent", "Yes", etc. Every trial ended successfully for the subject, either via an initially correct discrimination or a correction aided by the experimenter if necessary. Edibles were used only in the management of behavior problems not directly associated with discrimination performance, i.e., getting out of chair, constant looking around, general hyperactivity, etc.

Data collection involved recording the subject's response to each trial as correct or incorrect. If a correction was used, the trial was scored as incorrect and the subject's response to the correction was not recorded.

All subjects who performed 20 consecutive correct criterion discriminations within the 50 pretesting trials were eliminated from the study. Since they could already do the task or learn it quickly via differential reinforcement only, no purpose would be served in training them with attention-engineering procedures. Twenty-four of the 102 subjects reached criterion during the pretesting. Eight had been assigned to the ARLCD training condition, nine to the AFRD training condition, and seven to the combined ARLCD/AFRD training condition.

Training

The training procedures were the same for all subjects in all three groups, and involved the same demonstrations, training, correction, reinforcement and data collection procedures used in the pretesting phase. Only the features of the stimuli differed, as described above.

Subjects in each of the three groups received four phases of training, with progressively more difficult discrimination required in each phase. The discriminations required in each phase for the ARLCD, AFRD and ARLCD/AFRD groups are illustrated in Figure 1. Twenty consecutive correct discriminations were required before movement to the next phase. The criterion test stimuli were used with all groups in the fourth phase of training, and twenty correct discriminations with these stimuli constituted criterion acquisition.

Subjects in any condition who failed to learn the criterion discrimination within 700 trials were not trained further. Seven hundred trials was chosen as a stop criterion because it was believed that subjects who had not acquired the discrimination by then would not do so without a change in training procedures.

Results

Discrimination learning was assessed using two different measures: trials and errors to criterion acquisition. Because each of the three experimental training procedures had four phases, the data were analyzed using a two-factor analysis of variance with repeated measures on one factor (phases of training). Treatment (attention-engineering strategy) was the between subjects effect and phase of training was the within subject effect. Tables 3 and 4 show the raw score means, standard deviations and skewness of errors and trials to criterion for each phase of training and for criterion discrimination acquisition. These data are based only on those subjects who achieved criterion acquisition because no meaningful scores could be assigned to those who did not achieve criterion. Though varying numbers of subjects did not reach criterion in the three training groups (see Table 2), a chi-square significance analysis revealed no association between treatments and achieve not achieve criterion measures ($\chi^2 = 1.409$, 2 df, N.S.). Because treatment means and standard deviations tended to be proportional and the data were positively skewed, the data were logarithmically transformed into $\log_{10}(X + 1)$ form prior to parametric analysis (Kirk, 1968, p. 65).

Table 3

GROUP MEANS, STANDARD DEVIATIONS, AND SKEWNESS FOR TRIALS TO CRITERION AT ALL PHASES AND FOR TOTAL TRIALS TO CRITERION

	Treatment Groups								
	ARLCD			AFRD			Combined ARLCD/AFRD		
Phases	$\bar{X}$	S.D.	Skew	$\bar{X}$	S.D.	Skew	$\bar{X}$	S.D.	Skew
1	73.53	63.99	1.51	40.47	32.16	2.22	23.47	3.43	.59
2	36.47	23.87	1.63	28.29	12.16	1.54	27.53	12.57	1.24
3	46.29	30.92	.72	45.71	60.10	3.31	31.00	19.80	1.72
4	52.59	35.66	1.15	42.59	40.14	1.99	49.59	38.46	1.15
Total	208.83	98.66	.25	157.06	124.54	2.89	131.47	55.94	1.32

Table 4

GROUP MEANS, STANDARD DEVIATIONS, AND SKEWNESS FOR ERRORS TO CRITERION AT ALL PHASES AND FOR TOTAL ERRORS TO CRITERION

	Treatment Groups								
	ARLCD			AFRD			Combined ARLCD/AFRD		
Phases	$\bar{X}$	S.D.	Skew	$\bar{X}$	S.D.	Skew	$\bar{X}$	S.D.	Skew
1	19.24	26.27	1.57	7.65	11.37	2.10	1.71	1.61	.96
2	3.18	4.68	1.57	1.00	1.17	1.20	.94	1.60	2.08
3	4.65	6.62	1.16	4.06	6.47	1.83	.82	1.98	3.06
4	6.94	6.43	.81	6.76	13.07	2.42	8.41	11.38	1.64
Total	34.01	32.39	.85	19.47	24.81	2.19	11.88	11.94	1.45

Reliable effects due to type of training existed for errors ($F = 3.97$, 2/48 df, $p < .05$) and for trials to criterion acquisition ($F = 3.86$, 2/48 df, $p < .05$). Reliable effects due to phase of training also existed for errors ($F = 13.13$, 3/144 df, $p < .01$) and for trials to criterion acquisition ($F = 4.45$, 3/144 df, $p < .01$). In addition, reliable interactions were present between training procedures and phase errors ($F = 2.41$, 6/144 df, $p < .05$) and between training procedures and phase trials ($F = 2.48$, 6/144 df, $p < .05$). The logarithmically transformed errors and trials data are graphically displayed in Figures 2 and 3 respectively.

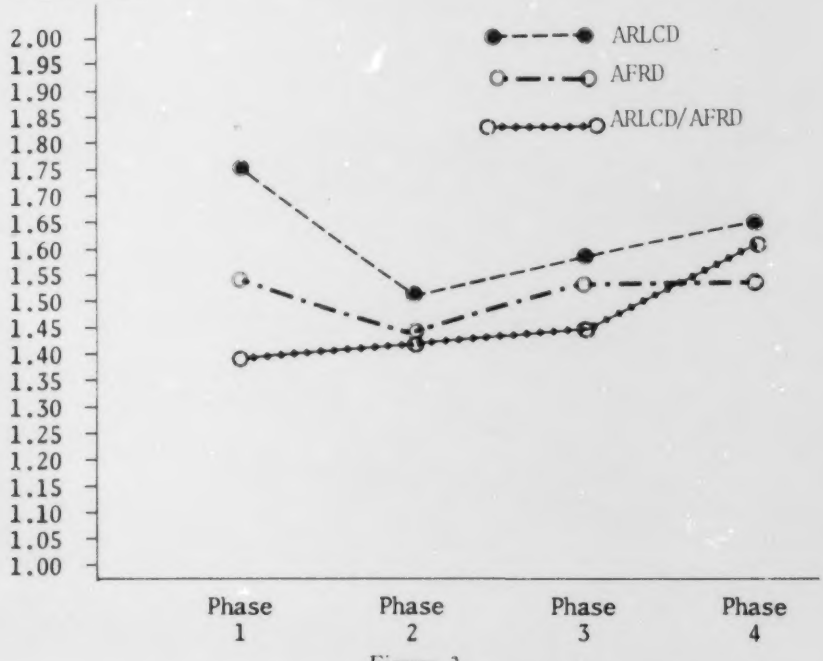


Figure 2

MEAN LOG_{10} $(\chi + 1)$ TRIALS TO CRITERION ACROSS PHASES OF TRAINING

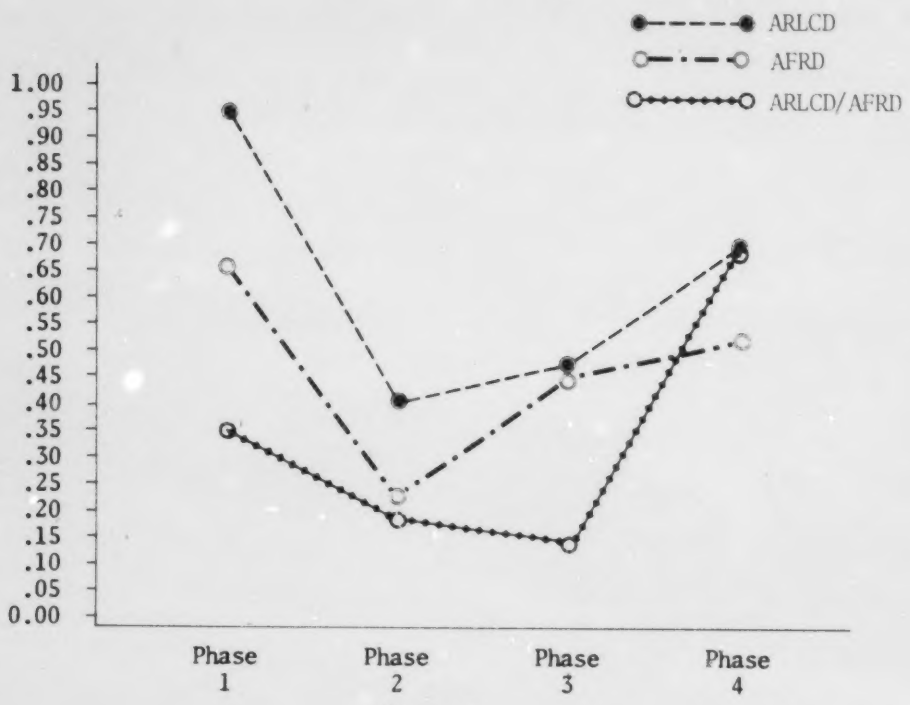


Figure 3

MEAN LOG_{10} $(\chi + 1)$ ERRORS TO CRITERION ACROSS PHASES OF TRAINING

Scheffé multiple means comparison tests revealed that: (1) all training groups significantly differed from one another in trials and errors to *phase one* criterion, with combined ARLCD/AFRD training producing by far the least trials and errors to phase one criterion, AFRD training producing next least, and ARLCD training effecting numerous trials and errors to phase one criterion; (2) errors decreased significantly and substantially between phases one and two of ARLCD and AFRD training (those treatments involving the most errors initially); and (3) trials increased significantly between phases three and four of combined ARLCD/AFRD training, and errors increased significantly between phases three and four of both the ARLCD and combined ARLCD/AFRD training (those treatments involving addition and reduction of large cue disparities on the relevant dimension of the criterion discrimination.

Because mean trials and errors were not significantly different *between* treatment groups in phases two, three or four, the reliable treatment effects for both trials and errors are attributable to differences in phase one of training. The significant phase effects on trials and errors can be attributed to the results of the Scheffé tests described above. The significant interaction effects were due to: (1) larger decreases in trials and errors from phase one to phase two of ARLCD and AFRD training than for combined ARLCD/AFRD training; and (2) a larger increase in trials and errors from phase three to phase four of combined ARLCD/AFRD training than for ARLCD or AFRD training (see Figures 2 and 3).

Discussion

One major focus of the study involved an assessment of the effects of combined ARLCD/AFRD training procedures on difficult visual discrimination acquisition by severely retarded individuals working with an assembly task. Such effects appeared to be extremely powerful. Combined ARLCD/AFRD training produced few errors ($\bar{X} = 11.8$) and a moderately low number of trials ($\bar{X} = 131.5$) to criterion acquisition (see Tables 3 and 4). In light of the fact that 80 trials was the minimum possible (20 consecutive correct discriminations in each of 4 training phases), the simultaneous initial presence of a high saliency redundant color dimension and exaggerated cue differences on a relevant dimension, with gradual fading of the color dimension and more gradual reduction of the exaggerated cues, had a pronounced facilitative impact upon performance.

In addition, the current findings also demonstrated that simple fading procedures can be used to eliminate a simultaneously present redundant color dimension without producing drastic increases in discrimination errors by severely retarded learners. No significant differences existed between the numbers of trials and errors, respectively, at phases one, two or three of combined ARLCD/AFRD training. Significant differences did exist, however, between the numbers of trials and errors, respectively, at phases three and four (see Tables 3 and 4). The lack of difference between phase one, two and three can be attributed to the initially very low numbers of trials and errors required to reach phase one criterion. Quite errorless responding was quickly established via combined ARLCD/AFRD training, and was maintained through phases two and three. In phase four, when all redundant color and exaggerated relevant dimensions and cues were removed, errors began to occur with a concomitant increase in trials to criterion. As will be addressed, though, in the following discussion of relative efficacy, the error/trial rates in phase four of combined ARLCD/AFRD training did not differ significantly from those in phase four of ARLCD or AFRD training and did not prevent relatively quick criterion performance.

The effectiveness of combined ARLCD/AFRD training appears to be related to the immediacy with which rather powerful stimulus control is established in phase one of training. Subjects averaged only approximately 1.5 discrimination errors and only three trials more than minimum in that initial phase. Successful learning and performance were established very quickly indeed.

The second major focus of the study involved investigation of the relative efficacy of ARLCD, AFRD and combined ARLCD/AFRD training procedures for facilitating difficult visual discrimination acquisition by severely retarded individuals working with an assembly task. Manipulations of different stimulus features did produce differential rates of discrimination learning. The initial simultaneous presence of a redundant color dimension and exaggerated cues on a relevant dimension facilitated difficult visual discrimination learning significantly and substantially better than did either individually. Such treatment differences were shown to exist only in the first phase of training. Once relatively errorless responding was established, it was maintained by all of the training strategies. There were critical differences between treatments, however, in their initial establishment of relatively errorless responding.

The findings also demonstrated that the presence of color as a redundant dimension may facilitate discrimination acquisition more quickly and errorlessly than does exaggerated cue difference on a relevant dimension. Both

AFRD and combined ARLCD AFRD procedures (those employing a redundant color dimension) produced significantly fewer errors and trials to criterion than did ARLCD procedures (see Tables 3 and 4). This finding, however, requires a great deal of qualification. The materials for ARLCD training in this study were purposefully restricted to inexpensive and readily accessible assembly objects. The rationale was that a training procedure has utility in a vocational skill training context only if its components are easily implementable. Stimulus control could have been more readily established in phase one of ARLCD training had stimulus objects had a larger disparity between cues on the relevant dimension. This qualification certainly limits the current findings. The implications of stimulus variable research for application to vocational skill training settings are limited, though, unless such a practical rationale for procedures is adopted.

One result requires further clarification. The number of errors, and thus the number of trials, increased between phases three and four to a greater extent in ARLCD AFRD training than in AFRD training. As with other "errorless" training strategies (Moore & Goldiamond, 1964; Sidman & Stoddard, 1967; Terrace, 1963; Touchette, 1968), errors began to occur when all redundant or exaggerated training cues finally disappeared. Two critical issues exist: did the error rate prevent acquisition of the criterion discrimination?; and, were there significant differences in error rates between treatment groups in this final training phase? The results of this study provide answers of "no" to both questions (see Tables 3 and 4). The combined ARLCD AFRD training procedures were quite effective, then, in focusing subjects' attention on the relevant shape of face of nut dimension. Their effectiveness was not negated by the increase in errors at phase four. Perhaps the addition of another step or two in the fading process would have eliminated this increase.

The overall relative efficacy results appear to derive primarily from the differential effectiveness of treatments for establishing immediate and powerful stimulus control. The effectiveness of the first phase of a training sequence appears to determine its overall effectiveness. Though, as Lawrence (1952) and others have illustrated, the intermediate phases are necessary because nongradual changes from large to small cue differences do not necessarily facilitate learning of a difficult visual discrimination.

Implications exist regarding the use of color cues in teaching difficult visual discriminations to severely retarded individuals. Color cues appeared to facilitate difficult visual discrimination learning to a significantly greater extent than did exaggerated cues on the relevant dimension of a criterion discrimination. This is an important finding because color coding fading techniques are so widely applicable and easy to implement. The power of color coding fading techniques appears to match their economy. Further, simple fading procedures were shown to be quite useful for eliminating high saliency redundant color cues used to establish initial discrimination responding by severely retarded people in practical skill training settings. It appears that color coding can be used for initial training purposes in vocational skill training settings and simple fading procedures can be used to move individuals toward skilled production.

Though ARLCD AFRD procedures proved to be most effective in establishing immediate stimulus control and the resultant correct discrimination performance, the current results indicated that color coding and fading alone (AFRD) may well be sufficient to teach difficult visual discriminations to severely retarded persons. The number of errors and trials to criterion was not large for those trained via AFRD procedures (see Tables 3 and 4). Because

stimuli with exaggerated cue differences on a relevant dimension (such as those required for combined ARLCD/AFRD training) are often difficult or expensive to locate, training via color coding/fading alone can be implemented first. Only if AFRD procedures fail, as they will for those for whom color has no saliency, should the more difficult to implement but more powerful combined ARLCD/AFRD strategy be employed.

An additional implication relates to errors during training. It is important to minimize errors because of their possibly debilitating effects on learning and performance by retarded individuals (Bialer & Cromwell, 1965; Butterfield & Ziegler, 1965; Gardner, 1965; Gold & Barclay, 1973; Sidman & Stoddard, 1967; Touchette, 1968; Zeaman & House, 1960). It was evident throughout the present study that relatively errorless learning tended to eliminate "emotional" responses incompatible with correct performance. Obviously, when a choice exists, a training strategy that produces the fewest errors by severely retarded learners should be chosen. The current results demonstrate that such a choice exists.

An important question posed by the findings relates to generality to other retarded adults. Subjects in this study were randomly selected from a defined institutionalized group labeled severely retarded. Fourteen of the 89 selected individuals did not reach the training criterion in the 700 trials allowed. This result is similar to that reported in other vocational training research. Large variation between subjects has been frequently observed, and a small percentage of subjects in some other studies failed to reach a defined criterion (Gold, 1972; Gold & Barclay, 1973). Thus, conclusions in the present and previous research may not be applicable to a small group of difficult-to-train adults. Further research is clearly needed with these individuals to identify efficient vocational training techniques.

The potential role of stimulus factors in vocational skill training has been clearly demonstrated. However, a number of important questions remain to be addressed by future research. These include, for example, examination of the utility of fading strategies for tasks involving several discriminations and assembly of several components; evaluation of possible relationships between attention-engineering strategies and reinforcement parameters; and analysis of possible interactions between kinds of tasks and various training procedures. The importance of this future research cannot be overemphasized. Attention-engineering procedures have proven to be powerful tools for teaching skills to severely retarded individuals. As a result, research on their range of possible application is warranted and can provide useful direction for even more refined training efforts.

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Cable Harness Construction for Severely Retarded Adults: A Demonstration of Training Technique

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Abstract

Three severely retarded adults were taught to construct an eleven-wire cable harness, similar to those available in many sheltered workshops. Individual training was used with two trainees, and these required a total of 18 and 35 hours of instruction before learning the task. Both the successful acquisition of this apparently difficult work task and the subsequent rates at which it was performed argue for inclusion of more severely and profoundly retarded adults in existing sheltered work programs.

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Cable Harness Construction for Severely Retarded Adults: A Demonstration of Training Technique

There are now many demonstrations that severely and profoundly retarded adults can learn realistic and potentially remunerative vocational skills (Bellamy, Peterson, & Close, 1975; Clarke & Heremelin, 1955; Crosson, 1967; Gold, 1975; Karen, Eisner, & Endres, 1974; Williams, 1967). Considered together these illustrations and experiments suggest that the ability of most severely and profoundly retarded adults to learn work skills is no longer at issue. A much more practical concern must now be addressed: Can training procedures be adapted to fit the unique characteristics of those tasks which are available to workshops in any given community?

This question follows directly from Crosson's (1969) suggestion that workshops "find ways" to teach retarded adults to perform available work rather than "find work" which the adults already can perform. The research cited above provides considerable evidence that many small parts assembly tasks which are available to workshops can be taught efficiently to severely retarded workers. In this report a training procedure is discussed for teaching the severely retarded to complete a somewhat different vocational task which has proven to be a realistic subcontract in workshops in the Northwest.

Method

Trainees

All three trainees were community residents and employees of the Specialized Training Program at the time of training. The pilot trainee was a 20 year old severely retarded Down's Syndrome woman who had resided at the major state institution for the past 16 years. Her only previous vocational training was in sorting and folding laundry, and although she had once been included in a language program, she was dropped after a few months for lack of progress. The trainee was non verbal, but could follow some simple directions. Institution records indicate a functioning level at AAMD Adaptive Level IV, an M.A. (Stanford Binet) of 2.6 years and Social Quotient (Vineland Social Maturity Scale) of 2.5 years.

Trainee I was a 26 year old Down's Syndrome woman labeled profoundly retarded. She resided in a state institution for 23 years, and her only previous work experience was on a woods crew where she was considered a poor nonproductive worker. Although institution records indicate an IQ (Stanford Binet) of 14, this trainee had functional expressive and receptive language.

Trainee II was a 19 year old severely retarded woman who had been institutionalized for the past 10 years. Previous vocational experience included bed making tasks in the institution and a small parts assembly task (Bellamy, Peterson and Close, 1975) in the present setting. She obtained an M.A. of 3.2 years on the Stanford Binet and a Social Age (Vineland) of 5.2 years.

The Work Task

The task was a cable harness subcontracted from Tektronix, Inc., Beaverton, Oregon. (See Figure 1.) The cable contains eleven wires and coaxial cables,

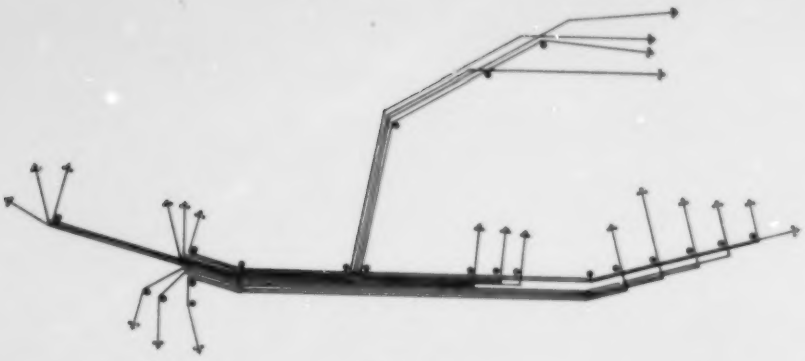

Figure 1
SCHEMATIC DIAGRAM OF THE ELEVEN-WIRE CABLE HARNESS

most of which are terminated with "peltola" connectors. It is laced with continuous elastic cord so that the original shape is retained when installed in an oscilloscope. Construction of the cable involved threading the wires on a cable board, completing the 79 steps listed in Table 1 (Phase I). The cable was then laced by tying approximately 75 self tightening knots at correct intervals (Phase II). Materials required for assembly include:

(1) The eleven wires, each color coded with two or three different colored spiral stripes.

(2) Elastic cord for lacing.

(3) An 18x24 inch plywood board on which the wires were threaded into position. Single nails on the board indicated channels for threading and pairs of nails denoted the beginning and termination points for each wire. A one inch sample of each wire was stapled to the cable board to mark both beginning and termination points with a match-to-sample cue.

(4) Two rows of one inch plastic tubes were mounted in a 10x20x30-inch wooden frame. This bin setup held the wires in sequential order during assembly.

(5) A small alligator clip was attached to the tubes during cable construction to mark the trainee's place in the bins.

Training Materials

During the procedure the trainer used: a stopwatch with which all trials were timed; a data sheet, on which trainee responses to each step in Phase I were recorded as correct or incorrect; pennies which could be exchanged by trainees for edibles during breaks; and a soldering hook, to untie incorrect knots in Phase II.

Training Procedures

Pilot training. The pilot trainee was unable to match color coded wires to identical samples at the outset of training. Therefore, pretraining on this match-to-sample skill was conducted, with training materials progressing from easy to hard on both size and color dimensions. The trainee then received direct instruction on the task in a large room where 5-10 other severely handicapped adults were working. The trainer was responsible for both the trainee and another adult throughout the training period. After initial demonstrations of each step of the task, the trainee was expected to complete the step inde-

Table 1
CONSTRUCTION STEPS IN PHASE I, THREADING OF WIRES

1. Place clip on bin 1
2. Pull out wire and match first sample
3. Wrap wire around nail
4. Thread on correct side of nails
5. Locate second sample
6. Pull wire tight
7. Wrap wire around nail

8. Move clip to bin 2
9. Pull out wire and match first sample
10. Clip wire between nails
11. Thread on correct side of nails
12. Locate second sample
13. Clip between nails

14. Move clip to bin 3
15. Pull out wire and match to sample 1
16. Clip between nails
17. Thread wire along path on correct side of nails
18. Locate sample 2
19. Clip between nails

20. Move clip to bin 4
21. Pull out wire and match to sample 1
22. Clip between nails
23. Thread on correct side of nails
24. Locate sample 2
25. Clip between nails

26. Move clip to bin 5
27. Pull out wire and match to sample 1
28. Clip between nails
29. Thread on correct side of nails
30. Locate sample 2
31. Clip between nails

32. Move clip to bin 6
33. Pull out wire and match to sample
34. Clip between nails
35. Thread on correct side of nails
36. Locate sample 2
37. Clip between nails

38. Move clip to bin 7
39. Pull out wire and match to sample
40. Clip between nails
41. Thread on correct side of nails
42. Locate sample 2
43. Clip between nails

44. Move clip to bin 8
45. Pull out wire and match to sample
46. Find PELTOLA end
47. Clip between nails
48. Thread on correct side of nails
49. Locate sample 2
50. Clip between nails
51. Pull wire tight
52. Push wire to board

53. Move clip to bin 9
54. Pull wire out, match to sample
55. Find PELTOLA end
56. Clip between nails
57. Thread on correct side of nails
58. Locate sample 2
59. Clip between nails
60. Pull tight
61. Push wire to board

62. Move clip to bin 10
63. Pull out wire and match to sample
64. Find PELTOLA end
65. Clip between nails
66. Thread along path on correct side of nails
67. Locate sample 2
68. Clip between nails
69. Pull wire tight
70. Push wire to board

71. Move clip to bin 11
72. Pull out wire, match to sample
73. Find PELTOLA end
74. Clip between nails
75. Thread along path on correct side of nails
76. Locate sample 2
77. Clip between nails
78. Pull wire tight
79. Push wire to board

pendently. When this was done, a variety of presumed reinforcers, including edibles, compliments and money were provided. Incorrect responses were followed by a correction procedure in which the trainer modeled or physically primed the correct response and then provided another opportunity for the trainee to respond immediately.

Training in Phase I. The two trainees were taught to complete the cable individually. During training, a trainee was seated at a table facing the cable board with the bin setup directly behind the board. The trainer either sat beside or stood behind the trainee. Training then progressed through the following general steps:

(1) The trainer used verbal and nonverbal cues ("Watch me.", "Look here.", pointing to task) and contingent positive social consequences to direct and maintain the trainee's attention to the task materials.

(2) With the trainee attending to the task, the trainer modeled the first step

in the task with an accompanying verbal label of the activity (e.g., "Get the wire.").

(3) The trainee was then directed to perform the step, and was provided as much physical assistance as needed to do it correctly. Direct physical priming of the hands continued until the trainee initiated the step alone.

(4) The physical assistance provided by the trainer was then gradually faded as the trainee learned to perform independently. Fading was done in two ways. The first involved fading the physical prime by gradually moving the trainer's hand from the initial position on the trainee's hand to positions further up the arm. A general sequence was from hand to wrist to forearm, to upper arm, to shoulder and finally to no contact. If at any point the trainee failed to make the correct movement, the trainer would return to the last position where a correct response was made and provide additional guidance in this position before further fading. This process was continued until the trainee could perform the step without trainer contact or cues.

The second procedure for fading trainer assistance consisted of dropping the direct verbal cues like "Move the clip" and replacing these with less specific instructions such as "What's next?" or "What do you do now?" These non-specific instructions were then removed altogether. If the trainee failed to initiate or perform a step, the trainer would provide a more specific verbal direction and/or a physical prime until the correct response was obtained.

(5) In this forward chaining procedure, new steps were added as soon as previous ones were performed independently. Thus the trainee began each session by independently completing the steps which had been previously learned and then received training on new steps in the manner already described.

(6) When a step which had previously been performed independently was incorrectly completed, the trainer interrupted the trainee with a correction procedure appropriate to the step. Correction procedures involved backing up one step in the chain and providing verbal directions, a model of the correct response or a physical prime. In each case, an attempt was made to give the trainee the least help necessary for her to complete the step correctly on an immediately subsequent opportunity.

(7) Presumed reinforcing events were used extensively during training with social consequences being provided for correct steps and money for completion of the task. A continuous reinforcement schedule for correct steps early in training was quickly faded to intermittent compliments for completion of previously learned steps.

(8) Training on Phase I continued until the trainee completed the setup three consecutive trials with five or less corrections from the trainer.

Training in Phase II. In Phase II trainees were taught to lace the cable by tying an elastic cord around all wires at set intervals. Procedures like those described above were used to first teach the trainees to tie the self tightening knot illustrated in Figure 2, then to check the knot for tightness by lightly

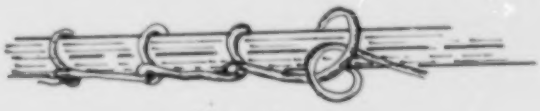

Figure 2

ILLUSTRATION OF KNOTS TIED IN PHASE II DURING CONTINUOUS LACING OF THE CABLE

rubbing one finger across the taut cord, and finally to tie the knots at the correct points on the cable. Teaching the tightness check represented an attempt to incorporate quality control behaviors in the assembly skills acquired by the trainees. If the cord remained in place during the check, the trainer was expected to proceed directly to the next knot. If, however, the knot was loose enough that the cord moved when rubbed, the trainee had to tighten the knot again, check it once more, and so on. Training on Phase II continued until five complete cables were constructed without error.

Data Collection. A step was considered correct when the trainee performed it without trainer cues or assistance. That is, a correct response was recorded when the trainee discriminated from cues in the task that a particular step was to be done and completed that step, making any additional discriminations necessary for accurate performance. Correct and incorrect responses during Phase I were recorded by the trainer on a data sheet in which all steps were listed sequentially as in Table 1. No specific checks of the reliability of trainer records were made in this research. In previous training studies in the Specialized Training Programs such checks were included, and agreement between independent records was for all practical purposes 100 percent (Irvin, 1975). No record of correct and incorrect responses was maintained in Phase II. All sessions in both phases were timed with a stopwatch and the exact duration of each training session was recorded.

Results

The pilot trainee attained the criterion of five consecutive correct cable assemblies after 72 hours of training during 49 work days. This included 15 hours in Phase I and 57 hours in Phase II, with a total of 143 trials (assemblies) during training. As was noted earlier, the trainer was responsible for both the trainee and another worker throughout this period.

Trainee I reached criterion in 35 hours, 6 in Phase I and 29 in Phase II. Training averaged 111 minutes per day during a total of 22 work days. As can be

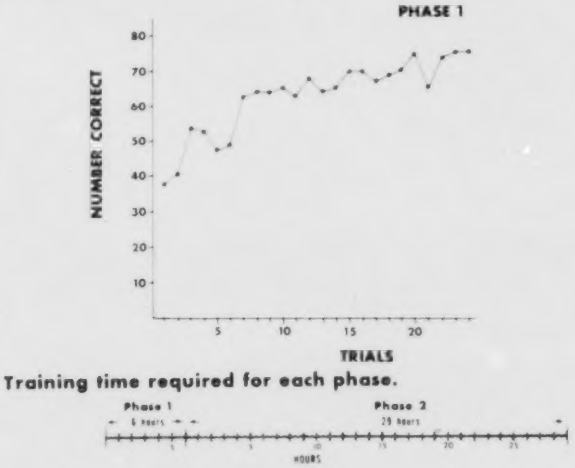

Figure 3

STEPS COMPLETED CORRECTLY BY TRAINEE I DURING PHASE I, AND TOTAL TRAINING TIME REQUIRED

seen in Figure 3, the number of correct steps during Phase I gradually increased from 38 on trial 1 to an average of 74.67 during trials 22-24.

Trainee II reached criterion in only 18 hours, 6½ in Phase I and 11½ in Phase II. Twelve days were required for training with an average of 96 minutes training each day. Figure 4 illustrates the trainee's acquisition of steps

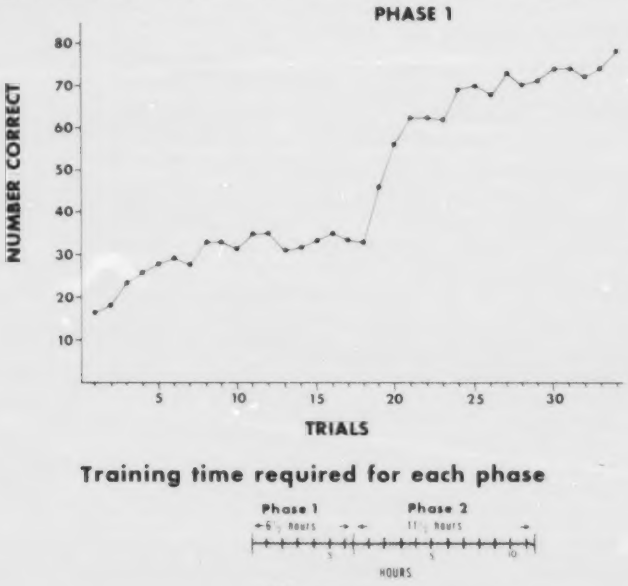

Figure 4

STEPS COMPLETED CORRECTLY BY TRAINEE II DURING PHASE I, AND TOTAL TRAINING TIME REQUIRED

in Phase I, with 16 correct steps on trial 1, trials increasing to an average of 74.67 during trials 32-34.

Discussion

The success of all three trainees extends the growing optimism about the vocational potential of the severely and profoundly retarded to an additional work task which is available to many sheltered workshops. The intent of this report was to increase the likelihood that severely and profoundly retarded adults would be included in these programs by describing an effective training procedure for harness construction.

If these adults are included in more workshop programs, a practical issue will relate to their productivity after training. Ultimate work rates not only will determine their earnings but also will contribute to the ability of workshops to include them over extended time periods. In this regard the two trainees in this investigation would appear to be excellent workshop employees. Both constructed the cable daily during four-hour work periods after training. Trainee I produced the cable at an average of 72 minutes per cable (24 percent industry time standard) during the first month after training and at an average of 24 minutes (73 percent time standard) during the third month. Trainee II produced it at an average of 67 minutes (26 percent time standard)

during the first month after training and at an average of 20 minutes (58 percent time standard) during the third month.

An issue warranting additional investigation is the establishment of criterion performance levels at which the individual training situation is replaced by a group production setting. Previous research has typically used an arbitrarily defined number of consecutive successful assemblies to denote completion of training (Bellamy, Peterson, & Close, 1976; Gold, 1972). Experience in the Specialized Training Program suggests that correct performance may be only one of the relevant variables. Research is needed on the utility of other criteria, including the amount of positive attention and the number of corrections provided by the trainer during assembly and the rate of assembly. Efficient use of a workshop's training resources dictates that individual training be terminated as soon as possible for each trainee. However, incomplete training can result in high rates of incorrect assemblies in the production setting. This, in turn, frequently means that the worker's contact with floor supervisors involves more corrections for inaccurate work than compliments for work well done. The possibility of shaping further incompetent work by such supervisor attention is apparent.

In evaluating the training procedure reported here it must be noted that no experimental designs were used to establish a causal relationship between the procedure and the trainees' acquisition of the work skills. It does seem rather unlikely, however, that factors other than the training procedure would have produced this complex behavior chain in each of the trainees.

Further research is clearly needed to apply the successful training approaches described here to still other work tasks which may be available to sheltered workshops. Whether subcontracts will be available for full employment of the many severely and profoundly retarded who now seem capable of such work is an open empirical and economic question. The chance of full employment will increase, however, if the range of work tasks available to them can be broadened through continued development of effective training procedures.

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PRODUCTION SUPERVISION

Habilitation of the Severely and Profoundly Retarded: A Review of Research on Work Productivity

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Abstract

Research on work rates of severely and profoundly retarded adults is reviewed to clarify the empirical basis for supervision procedures in sheltered workshops. A variety of relationships between productivity and characteristics of the work setting are apparent. Supervisor instructions preceding work, positive contingent consequences, modeling and social facilitation, and more general aspects of the work setting can all affect production rates. The applicability of these relationships to practical workshop settings is limited by the lack of more precise information about the relationships and by some systematic differences between typical research settings and the situations in which the severely and profoundly retarded are likely to work. Future research should focus on the development and evaluation of practical supervision procedures and evaluation techniques in realistic work settings.

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Habilitation of the Severely and Profoundly Retarded: A Review of Research on Work Productivity

The ability of severely and profoundly retarded adults to learn a variety of difficult and potentially remunerative vocational skills has been amply demonstrated, especially in job clusters involving small parts assembly or manipulation (Williams, 1967; Crosson, 1967; Gold, 1974; Bellamy, Peterson, & Close, 1975). The practical utility of these skills will depend to a large extent upon the rates at which they are ultimately performed and the kind of supervision required. Not only does production rate have a direct relationship to remuneration; it is also a basis for classification of both individuals and programs by the U.S. Department of Labor and most state rehabilitation agencies. Further, some data is available that work rates may be a determinant of supervisors' global performance ratings, on the basis of which employment decisions can be presumed to be made (Chaffin, 1969).

The purpose of this review is to identify factors which account for inter- and intra-individual variability in production rates of severely and profoundly retarded workers. Three general classes of these factors can be distinguished:

(1) Person characteristics, or attributes of individual workers which produce differences in rate. Much research on vocational assessment addresses the relationship between person characteristics and rate, and because extensive reviews of this work are available elsewhere (Windle, 1962; Cobb, 1969; Gold, 1973a), it will not be considered here.

(2) Task characteristics, or quantifiable properties of the work tasks themselves which might contribute to variation in rate. The possible effect of these variables has received little attention. Except for studies of required response force (Schroeder, 1972a) and visual complexity (Stevenson & Fahel, 1961) and an interest in cycle time (Gold, 1973a), few quantifiable task characteristics have concerned researchers working with retarded subjects. However, several authors have observed that task variables like novelty and complexity do *seem* related to performance (Gold, 1973b; Tate & Barhoff, 1967; Kahn & Burdett, 1967), and further study of these variables is needed.

(3) Setting characteristics, or physical and social aspects of the performance setting which can contribute to rate variability. Setting characteristics include specific reinforcement contingencies, supervisors' instructions, organization of the work area, length of work periods, and so on.

Although all three sets of variables have implications for the design of vocational programs, this review will consider only the third, the effect of setting characteristics on the work rates of severely and profoundly retarded adults. Because of the dearth of vocational research with this population, research will be included which deals with higher level retarded persons, and the applicability of this work to the more severely retarded will be discussed. Similarly, rate of work production in a sheltered work setting is the criterion of interest, but research dealing with frequency of performance or persistence of various manual behaviors in several settings will be considered. The review will not include studies of variables such as reaction time, measures of

skill acquisition or task attending, whose relationship to productivity is less clear.

Since the purpose of this review is to provide a critical evaluation of relationships between setting events and productivity, analysis of these relationships, rather than descriptive accounts of specific studies, will structure the presentation. This will result in repeated reference to some studies that provide data relevant to several relationships, and relatively brief presentation of others which only provide support for relationships that are more clearly established by other work. The review will consider the effects of specific antecedent events on productivity, the effects of consequences of work, and then the effects of more general setting characteristics. Finally, some methodological issues affecting the utility of the results will be discussed and future research needs identified.

Effects of Antecedent Events

Antecedent events considered here are specific social activities which precede the work performance of the worker or subject. Effects of instructions which specify the desired performance, encourage competition and set production goals will be reviewed.

Instructions Specifying Desired Performance

Evidence for a relationship between production rates and supervisors' instructions specifying desired behavior is provided directly in a few studies and indirectly in several others. Evans and Spradlin (1966) used a laboratory plunger-pulling task to evaluate the effects of instructions and various incentive schedules on the behavior of retarded subjects. Statistically significant differences were found between performance with monetary incentives and with simple instructions to "pull the knob as many times as you can", but the actual advantage of the incentive condition was less than five percent of the total responses. To check their conclusion that instructions seemed to account for much of the variability in responding, the authors successfully eliminated and then reinstated the pulling response with verbal instructions. The study thus provides evidence of the effects of instructions on rate, although the generality of these results may be limited by the fact that all subjects performed for incentives before the effects of instructions were examined.

Headrick (1963) used a similar task to compare the performance of retarded subjects who were instructed to "pull the knob" with others who were given non-definitive instructions. Definitive instructions led to persistent performance in some subjects and erratic rates in others, but apparently disrupted the development of fixed interval schedule control, which was more likely to develop with the non-definitive instructions.

Allyon and Azrin (1964) studied the effects of instructions and incentives on retarded and schizophrenic patients' behavior of selecting eating utensils at mealtime. Incentives without instructions explaining expectations did not improve performance appreciably, but improvement did follow when subjects were also instructed to perform the desired behavior. In a second study, instructions alone occasioned a moderate gain in performance which decreased somewhat over time, but then increased dramatically with the addition of incentives. The authors suggest that incentives and instructions have a complementary effect, and interpret their results as consistent with Skinner's (1957) analysis that verbal instructions will be effective only to the extent that they signal the opportunity to obtain reinforcement.

Results of several additional studies are consistent with the above evidence for an instructional effect, although they provide no specific experimental evidence. Hunt and Zimmerman (1970) increased rates of mildly retarded subjects on a task of counting pages for a telephone scratch pad by providing incentives, but were unable to reverse performance to the original level when subjects were instructed, "We want to see how many pads you can count without your bonus." Gordon, O'Connor and Tizard (1955) evaluated the effects of various instructions and incentives with moderately and severely retarded subjects whose task was to insert small nails into an aluminum frame. Simple instructions to work as fast as possible were less effective in increasing rate than were other manipulations, but the actual magnitude of the difference, like the Evans and Spradlin (1966) results, was slight. An apparent instructional effect is also reported by Tizard (1967), who was able to increase performance on complex jigsaw puzzles by verbal encouragement. Ellis and Distefano (1959) compared the pursuit rotor performance of retarded subjects who received praise and urging between trials with those who did not. The urged and praised subjects performed significantly better than did the controls, but of course this could have resulted from either the instructions (urging) or the possible incentive effects of the praise.

Instructions to Compete

Verbal instructions to compete with a peer or coworker have received some experimental attention. Gordon, O'Connor and Tizard (1955) compared the effects of instructions to compete in teams and to compete against a single peer with simple instructions to work as quickly as possible. Both competition groups outperformed the the simple instruction group, but the magnitude of this advantage was slight.

Huddle (1967) found no differences between overall scores of moderately retarded subjects who were instructed to work cooperatively, competitively, or alone in assembling television rectifier units. However, when performance records from the final (sixth) week were analyzed, a significant interaction between instructional group and incentive was found. Inspection of the data suggests that the competition group was superior to others in the reward condition, but not in the no-reward condition. Of course, the analysis of both the total and final data sets increases the experiment-wide error rate and suggests the use of caution in interpreting this result.

Instructions Which Set Performance Goals

Goal setting instructions evaluated in this section are those which establish performance criteria prior to the outset of work. Gordon, O'Connor and Tizard (1954) evaluated the effects of goal setting, encouragement and simple instructions on the performance of moderately and severely retarded subjects. The experimental tasks involved maintenance of an uncomfortable leg position for as long as possible, and the dependent variable was a measure of persistence. The goal setting procedure involved placing a clip on a cardboard timer, with which the subject could visually monitor his performance in relation to the goal. The goal group was significantly more persistent than the other groups, maintaining the position approximately twice as long. Unambiguous interpretation of this result as a goal setting effect is impossible, however, since the goal setting procedure was confounded with visual representation of performance throughout each trial. No such visual representation was provided the other groups.

Zimmerman, Overpeck, Eisenberg and Garlick (1969) present data on three individual workers in a prevocational program which is relevant to the effects of goal setting. Each performed a terminal board assembly task, and the goal setting procedure involved telling subjects the average number of units per hour which were expected. Subjects were informed at the end of each day whether they had reached the goal. For one subject the goal of eight units per hour was met only one of seven days, and the procedure had little effect on performance rate. Addition of negative consequences to the goal procedure did not improve performance significantly. With a second subject, the goal setting procedure reduced the variability of performance from the baseline condition and resulted in goal attainment on eleven of seventeen days. That this did not result in a substantial average increase in productivity may have been due to an insufficiently high goal, but increases were noted when positive incentives were added to the goal procedure. The order of presentation of goal and incentive condition was reversed with a third subject. A goal setting plus incentive condition increased performance over baseline levels, and this increase maintained when only the goal setting procedures were in effect.

Kleibhahn (1967) compared the performance of retarded subjects who were asked to set a goal for each day's production after learning of the previous day's total with the performance of a control group working under unspecified conditions. Both quality and quantity were superior in the goal group, although the method of data analysis produced a large experiment-wide error rate.

Summary of Antecedent Events

Supervisors' instructions preceding work thus appear to have some effect on productivity, although much of the literature fails to rule out alternative explanations of performance changes. Further, little information is provided on the magnitude of the effect, its durability in the absence of incentive conditions, or the circumstances under which it is likely to occur. The data which are available are consistent with Skinner's (1953) interpretation that the control exerted by antecedent events over such behaviors as work rate is dependent on prior exposure to particular consequences for the behaviors.

The applicability of these instructional effects to the severely and profoundly retarded is unknown, inasmuch as language and communication deficits are characteristic of this population. However, evidence is available that nonlanguage antecedent events can affect behavior rates after previous association with contingent consequences (Redd, 1972).

Effects of Consequent Events

Environmental events considered in this section are those which are the contingent results of vocational behavior. Most of the research reviewed has resulted from an interest in applying principles of operant conditioning to sheltered workshop operation (Linde, 1962; Campbell, 1971), and it has sought to demonstrate functional relationships between behavior rates and aspects of the consequent events.

Consequent events whose presentation as a contingent result of a behavior increases the rate of that behavior are termed reinforcers. Efforts to identify and utilize positive reinforcers in vocational settings are reviewed here as effects of positive consequences or incentives. Consequent events whose contingent presentation decreases behavior rates can be termed punishers or aver-

sive events, and relevant findings are reviewed here as effects of negative consequences.

Effects of Positive Consequences

That positive consequences can be found which do, in fact, increase the productivity of retarded workers has been demonstrated with such events as money (Schroeder, 1972a; Evans & Spradlin, 1966; Huddle, 1967; Brown, Van Deventer, Perlmutter, Jones, & Sontag, 1972); music (Bellamy & Sontag, 1973; Podvin, 1967; Cotter, 1971); edibles (Brown, Johnson, Gadberry, & Fenrick, 1971); choice of work assignment (Zimmerman, Overpeck, Eisenberg, & Garlick, 1969); increased frequency of supervisor contact (Bellamy, Peterson, & Close, 1975); and knowledge of results (Levy, 1974; Jens & Shores, 1969). The effect of incentives has been demonstrated in both between-subject (Crosson, 1967; Gordon, O'Connor, & Tizard, 1955) and within-subject designs (Zimmerman, Stuckey, Garlick, & Miller, 1969; Schroeder, 1972b), and in both laboratory (e.g., Evans & Spradlin, 1966) and applied settings (e.g., Brown & Pearce, 1970).

This effect has been so extensively replicated that specific methodological weaknesses of individual studies and isolated failures to demonstrate the effect (Kahn & Burdett, 1967; Perry & Stotsky, 1965; Karen, Eisner, & Endres, 1974) cast little doubt on the existence of a relationship between positive consequences and production rate. Therefore, studies will not be presented in detail in order to establish this relationship. Rather, the review will focus on common procedural characteristics which help to define more precisely the parameters of the incentive effect and the conditions under which it obtains. Of specific concern are the relative effects of instructional, informational and rewarding aspects of the incentive procedures.

Procedural characteristics. As Kazdin (1973) notes in his review, most reinforcement studies fail to distinguish between the effect of instructions to perform in certain ways, the incentive itself, and the informational feedback aspects of the reinforcement system. In the current context this suggests that although extensive evidence indicates that productivity is increased by incentive procedures, it is difficult to determine the specific aspects of the procedures which produce this result.

An example of the simultaneous changes in instructions and incentive conditions noted by Kazdin (1973) is provided by Bellamy and Sontag (1973). Subjects performed an assembly line envelope stuffing task both with and without incentives. In the no incentive condition subjects were instructed, "Begin work when I say 'go' and stop when the timer rings. Do a good job. Go.", while the instruction during incentive conditions specified both the desired response and the contingency, "The music will be on only after (Subject 4) places each envelope on the packaging box. You can keep the music on by working fast. Do a good job. Go." Although this potential confound was explicitly avoided in some laboratory studies (Greene & Hoats, 1969; Cotter, 1971), it is a problem in most of the applied research demonstrating incentive effects. Evidence that such instructions can affect performance rate is presented above. However, in light of the previously reported research of Allyon and Azrin (1964) and Zimmerman, Overpeck, Eisenberg and Garlick (1969), it seems unlikely that instructions could account for the entire incentive effect.

Kazdin (1973) suggests that a similar problem arises when the relative effects of the informational feedback and the incentive aspects of a reinforcement procedure are examined. At issue is whether the effects attributed to incen-

tives are instead the result of the informational feedback about performance which is inherent in the procedure. Evidence that such information about performance can improve work rates without other intended incentives is provided by Jens and Shores (1969), whose moderately retarded subjects either assembled a hinge mechanism or completed a packaging task during fifteen minute periods. The number of units was charted for each subject on a frequency polygon during treatment phases but not during control phases. The results of a reversal design for each of three subjects suggest that the charting procedure did increase rates, although analysis of variance of the group data demonstrated a significant charting effect for only one of the two tasks.

Loos and Tizard (1955) initially obtained a similar increase in productivity by representing the box folding rates of moderately and severely retarded subjects with histograms. However, the feedback condition was in effect considerably longer than in the Jens and Shores (1969) study, and after six weeks its effect had gradually reduced to initial levels.

Zimmerman, Stuckey, Garlick and Miller (1969) also report relevant data. Subjects worked on a terminal board assembly or bag folding task under a baseline condition, in which no feedback was given, a token incentive condition, where the number of points earned was calculated and communicated to subjects at the end of each day, and a practice condition, in which subjects were told at the end of each day how many points they would have earned had the token system been in effect. The practice condition improved performance above the baseline level, but not to as great an extent as the token procedure. Thus, effects of the token incentives used by Zimmerman *et al.* (1969) cannot be accounted for solely by the informational feedback characteristics of the procedure.

Two issues are apparent in these studies. First, information about performance can serve as reinforcing or accelerating consequences for work behaviors, although some evidence suggests that this effect may be weaker or less persistent than if additional positive consequences are also used. The second issue is somewhat more problematic, and is discussed extensively by Kazdin (1973). Except for the evidence presented by Zimmerman *et al.* (1969), the available research does little to rule out an interpretation of the reviewed rate increases as informational processing effects. That is, the reported production increases might be viewed either as an effect of the particular incentive used, or as an effect of the informational feedback provided by the intervention procedure. This distinction may be important in applying research results to the severely and profoundly retarded, inasmuch as different incentive procedures may provide informational feedback which is differentially useful to a population characterized by language and cognitive deficits.

Relevant reinforcement parameters. Several characteristics of procedures involving positive consequences may also affect production rate. Extensive data are available with human and infra-human subjects on the effects of schedules, latency, magnitude and type of reinforcement. This section will consider selected studies which seem most relevant to the behavior of severely retarded subjects.

Schedule effects. Additional variability in production rates may be accounted for by the schedule on which reinforcing consequences for work are made available. Schedules of reinforcement are rules which specify when a particular behavior will be consequated. In a *continuous* schedule, each emission of the defined behavior is followed by the consequence; in *ratio* schedules, the consequence is delivered only after a *fixed* or *varied* number of responses have been emitted; and in *interval* schedules, the consequence is delivered only

after the first response following a *fixed* and *varied* amount of time. Although the typical response patterns which these and more complex schedules generate in infra-humans (Ferster & Skinner, 1957) have only been partially replicated with severely retarded subjects, they do appear to be significant factors in performance variability. Spradlin and Girardeau (1966) and Weisberg (1971) reviewed the effects of schedules on the severely retarded and concluded that: (1) ratio schedules produce high and relatively stable response rates in relation to continuous schedules, while considerable inter- and intra-subject variability results from interval schedules; and (2) variability in responding under interval schedules seems related to instructions given subjects, subjects' prior exposure to other schedules, and response cost. Schroeder (1972a) extended the study of ratio and interval schedules to a work performance setting. Subjects were mildly and moderately retarded adults doing repetitive work which could be mechanically recorded by measures of tool usage. Performance rates under fixed interval schedules decreased as the frequency of reinforcement decreased, while performance rates under fixed ratio schedules increased as frequency of reinforcement decreased.

Similarly, Evans and Spradlin (1966) evaluated the difference between a piece-rate (fixed ratio) and salary schedule of reinforcement on the plunger-pulling rates of mildly retarded adults. Subjects responded at significantly higher rates under the piece-rate condition, although the actual difference accounted for only about 10 percent of the total productivity.

The applicability of these schedule effects to applied vocational settings may be limited by the reliance in this research on short repetitive tasks. Whether the same effects will be obtained with more lengthy tasks like those described by Silvern (1963), Gold (1972) and Barhoff and Tate (1966) has received little attention. An exception is the work of Crosson (1967) who increased work rates on three somewhat lengthy tasks with continuous reinforcement for task completion behaviors. On the basis of his count of distinct behaviors involved in each task, Crosson suggested that different fixed interval schedules were actually in effect for each task. Interpretation of differences in performance as schedule differences, however, ignores the possibility raised by Schroeder (1972a) that type of contingency may interact with the characteristics of behaviors required in workshop tasks.

Special feedback arrangements. Evidence is also available that work rates can be increased by the addition of mechanisms to provide continuous feedback about performance in relation to requirements of particular schedules of reinforcement. Trybus and Lacks (1972) increased production rates of a mildly retarded worker with continuous token rewards for work-appropriate behavior. Dramatic additional increases were noted, however, when cuing lights were used throughout the work period to signal whether behavior was work-appropriate. A similar continuous feedback effect was found by Baumeister, Hawkins and Holland (1966) with the addition of a supplementary auditory signal to a pursuit rotor task. The procedures used in a variety of other studies applied continuous feedback procedures similar to addition of a counter (Honig, 1966) to the schedule at hand (Gordon, O'Connor, & Tizard, 1954, 1955; Huddle, 1967; Walton & Begg, 1955). In the studies cited which failed to demonstrate an incentive effect on work rates, none provided such continuous feedback (Kahn & Burdett, 1967; Perry & Stotsky, 1965; Karen, Eisner, & Endres, 1974).

Types of reinforcement. As was noted above, the effects of positive consequences apparently obtain with various kinds of consequences. There are some data, however, suggesting differential effectiveness of various reinforcers for

the behaviors of the severely retarded. Watson, Orser and Sanders (1967) used a token reinforcement system to maintain the plunger-pulling performance of severely retarded children and compared the number of tokens which were exchanged for edible and manipulatable consequences. Although no initial differences were apparent, a marked preference for the edibles was noted over an extended period.

Tramontana (1972) evaluated the differential effectiveness of praise, candy and no consequence as continuous reinforcers for marble dropping behaviors of severely retarded children. The candy reinforcers produced higher behavior rates than did either the praise or no consequence conditions, which did not differ.

The conclusion that edible reinforcers have been generally more effective with the severely retarded is limited, however, by the findings of Hollis (1964). Subjects who were performing bent wire problems for edible rewards were changed either to social rewards or no consequence conditions, and then returned to the edibles. Subjects who were shifted to the no consequence condition had significant drops in performance, while those shifted to praise did not.

Other reinforcement parameters. Spradlin and Girardeau (1966) noted in their review that little attention had been given the effects of such reinforcement variables as latency and magnitude with severely retarded subjects. This is still the case, although the effects of these variables with infrahuman subjects suggest that they may indeed be relevant to the work performance of this population.

Other reinforcement effects. Karen, Eisner and Endres (1974) used token reinforcement procedures to improve the work performance of severely retarded adults on several simple tasks involved in nursery speciman can construction. Tokens were given contingently for such behaviors as visually attending to the task, being at the proper work station, wearing an apron, and using the time clock. The procedure decreased the number of verbal prompts used to maintain visual attending and reduced the errors made by workers. It did not affect production rate, however, and this is consistent with evidence on incentive effects presented earlier. No contingency relationship is apparent between the tokens and specific production behaviors.

Teasdale and Joynt (1967) used social incentives and goal setting procedures to increase work rates of moderately and severely retarded adults on a label threading task. Although the authors did successfully increase productivity, they expressed concern that such procedures may be detrimental inasmuch as they also reduced social interaction, increased non-purposeful activity, reducing smiling and increased verbal aggression. As with Karen, Eisner and Endres (1974) results, this effect seems to emphasize the importance of the contingency relationship between incentives and specific behaviors of subjects, for extensive documentation is available elsewhere that the social behaviors of concern to Teasdale and Joynt (1967) can be modified with contingent consequences (e.g., Gorton & Hollis, 1965; Girardeau & Spradlin, 1964; Burchard, 1967).

Effects of Negative Consequences

Although Weisburg (1971) and Gardner (1969) noted in their reviews a marked increase in the clinical use of punishment procedures with the retarded, only two of the studies reviewed demonstrated that negative consequences could be used to increase work productivity. Greene and Hoats (1969) allowed a mildly retarded subject to watch television while performing a card

sorting task. Distortion of the television reception unless a task cycle was completed within a given interval increased the subject's work rate.

Zimmerman, Overpeck, Eisenberg and Garlick (1969) increased the work rates of five workers with an isolation avoidance procedure. In the procedure, subjects' failure to meet a specified average production rate for any given day resulted in working in isolation on the following day.

Similar effects of productivity have been noted with the use of music as a consequence for work, and necessarily, absence of music as a consequence for failure to work (Podvin, 1967; Bellamy & Sontag, 1973; Cotter, 1971).

Summary of Effects of Consequences

Extensive evidence relates increases in production rates to the contingent provision of consequences for work. This effect has been demonstrated with a variety of specific consequences, and with several different production behaviors, and has been shown with the severely retarded population of concern here. The various effects of specific components of the reinforcement procedures on the behavior of this group are considerably less clear, as are the interrelationships among variables which appear related to production rate.

Effects of General Setting Characteristics

Evidence is considered in this section which relates production rate to setting characteristics which are more general or durable than the specific antecedent and consequent events analyzed in previous sections.

Effects of Social Facilitation

The possibility that the presence of other workers can increase productivity is raised by Abel (1938). Manual performance of high- and low-IQ mildly retarded girls was compared when working alone and working in pairs. Each subject worked under both conditions, and performance while working in pairs was significantly greater. In addition, subjects' performance improved more from previous trials when working in pairs than alone. There was some indication, however, that the social facilitation effect was weaker for the low-IQ group.

A social facilitation effect is also suggested by the comments of several authors that "spontaneous" competition developed among subjects (Brown, Johnson, Gadberry, & Fenrick, 1971; Huddle, 1967).

Two additional studies evaluated the effects of presence of a competent coworker on productivity, thus combining possible effects of social facilitation and modeling (Bandura, 1969). Brown and Pearce (1970) applied this procedure to the work performance of trainable retarded adolescents. The subjects performed an envelope stuffing task while either working alone or working at a table with models who were performing at a high rate. Superiority of the modeling condition was demonstrated in a reversal design with two of the four subjects.

Kleibhahn (1967) compared the performance of retarded subjects who worked at a table with a competent confederate model with an unspecified control condition. The modeling condition resulted in higher quality and quantity of performance, although the method of data analysis resulted in an experiment-wide error rate which limits confidence in this effect.

Effects of Environmental Distraction

Somervill, Jacobsen, Warnberg and Young (1974) evaluated the performance of institutionalized retarded children on simple pegboard and puzzle tasks under three environmental conditions: working alone in a small cubicle, working in "typical classroom" conditions, and working under very high levels of auditory and visual distraction. Subjects were classified by teachers as either distractible or non-distractible. A significant working condition effect on time required for task completion was obtained with very high levels of distraction producing the poorest performance for each group, then the typical classroom condition, and finally the cubicle condition. The authors suggested that a difference in the distractible group between the high distraction and normal conditions may account for the significant effect.

Effects of General Supervision Style

Tizard (1953) compared the effects of three general styles of supervision on the work performance of mildly retarded workers in an institutional workshop. The three supervision styles were intended to approximate patterns which were commonly found in the supervision of institution employees. In the "strict" supervision, workers were given criticism and blame for poor performance; "friendly" supervision relied on the use of praise and encouragement for appropriate work; and in "laissez-faire" supervision the supervisor remained aloof, giving neither praise nor criticism. Behavior was rated as more industrious under the strict and friendly than under the laissez-faire supervision on the basis of both time sampled behavior observations and supervisors' ratings. The laissez-faire supervision produced more talking generally and more distracting talk.

Summary of General Setting Effects

Demonstrations are thus available that general characteristics of the settings in which work is performed can affect work rates without specially programmed antecedents or consequences for work. Little evidence is provided, however, about the durability of these effects, their possible interactions with antecedent and consequent events, or their applicability to the severely and profoundly retarded population of concern here.

Methodological Characteristics Affecting the Utility of the Research

The usefulness of this research in applied settings depends on the extent to which the reported relationships are clearly established in the various studies and the extent to which the relationships can be generalized to non-research settings. The first issue is one of internal validity and the second, one of external validity (Campbell & Stanley, 1963). This section will consider representative problems of both internal and external validity in the research, and will evaluate the relevance of the findings to the sheltered workshop performance of severely retarded adults.

Internal Validity

Critical design weaknesses of individual studies were noted in the review when they cast doubt on the validity of the relationships under consideration.

One of the most persistent problems of internal validity in this research is that of ruling out of the effects of practice as a determinant of the observed performance changes. Improvements in performance over time or across trials in the absence of specific setting manipulation is apparent in the no treatment groups of several investigations (Gold, 1973b; Claridge & O'Connor, 1957; Kahn & Burdett, 1967; Gordon, 1962; Reynolds & Stacey, 1955; Hollis, 1962; Tobias, 1960). In a few studies a gradual improvement in performance across trials seems to account for considerably more variance in the productivity of some subjects than do specific treatment conditions (Brown and Pearce, 1970; Brown, Bellamy, Perlmutter, Sackowitz and Sontag, 1972; Perry and Stotsky, 1965).

Because several studies do rule out the effects of practice through careful experimental design, these effects cannot account for all the reported changes in productivity. The extensive replication of a practice effect, however, casts doubt on any relationship which is observed in a design which does not control for practice as a causal explanation.

External Validity

Multiple treatment interference. Multiple treatment interference concerns the possibility that the effect of a particular treatment may depend on the subject's prior exposure to other treatments. A possibility in all intra-subject designs, this problem is particularly relevant to the current research. Several demonstrations are available that the effects of a variety of setting characteristics, including both antecedents and consequences of work behavior, are different depending on other treatments which may have preceded them (Gordon, O'Connor, & Tizard, 1954; Stevenson & Snyder, 1960; Siegel, Williams, & Forman, 1967; Noonan & Barry, 1967). These data suggest that multiple treatment interference can reduce the generality of findings about setting characteristics. The possibility raised by Kazdin (1973) that the kind of design (intra- *vs.* inter-subject) may interact with treatment effect thus merits close attention in evaluation of the present literature. The applicability to actual vocational settings is clearer when an effect has been demonstrated in a variety of designs, as is the case, for example, with the effects of positive consequences.

Reactive effects of experimental arrangements. These threats to external validity result from systematic differences between the experimental setting in which effects are demonstrated and other settings to which one may wish to generalize. In the research considered here these differences typically include the presence of behavior observers in the work setting, the use of short simple tasks, and the conduction of experiments during shortened work days.

Evidence that the presence of observers can alter the behavior being observed is provided by Bechtel (1967), who noted that when given a choice, individuals tended to avoid situations where observers were present; by White (1972) who noted general decreases in activity level as a result of observer presence; and by Kent, Fisher and O'Leary (1974) who noted changes in task orientation when observers were present. The extent to which the typical presence of observers limits the generalizability of the workshop studies reviewed here can only be surmised, although the demonstration of similar relationships with observers and mechanical recording devices (Tate, 1968; Schroeder, 1972a, 1972b) argues against this possibility.

The typical reliance in the research on short repetitive tasks was noted above. It is unclear whether all the apparent relationships between setting events and productivity will hold if the variety and complexity of workshop

contracts is increased following the recommendations of Crosson (1969) and Gold (1973a).

Similarly, generality of findings from the brief experimental periods used in much of the research to full work days may be uncertain. However, a few studies have analyzed performance during full days (e.g., Zimmerman, Overpeck, Eisenberg, & Garlick, 1969), and the specific relationships observed are consistent with the more restricted studies.

A further problem related to external validity of the research may arise when findings are used to account for variability in production rates of the severely and profoundly retarded in applied settings. These settings likely will involve long-term involvement, varied work assignments, and a simultaneous interest in productivity and social behaviors (Teasdale & Joynt, 1967). Thus the applicability of findings may be limited by relative neglect in the research of such issues as developing strategies for generalization and maintenance; identifying optimal methods of staff training when experimenters are not present; and designing environments for simultaneous changes in a variety of behaviors.

Summary of Methodological Characteristics

Confidence in the validity and generalizability of the relationships reviewed above is increased by the presence of a few exemplary experiments and the extensive replication of some relationships in a variety of studies, each having different methodological strengths and weaknesses. This confidence is particularly warranted in the effects of broad setting characteristics, including contingent positive consequences, supervisor instructions preceding work, modeling and social facilitation, and other general aspects of the work setting.

Clarification of more specific details of these effects, however, is considerably more difficult because of the absence of critical studies or methodological problems in those which are available. We simply do not yet know the exact conditions under which many of the reported effects can be expected to obtain. Nor is it clear what combination of setting characteristics will produce maximum productivity. Specific details of antecedent, consequence and general setting effects are similarly unknown, and more research is needed to define the nature of these relationships.

Some Needed Research

Lindsley (1964) suggests that retardation may reflect less a mental deficit in the individual so labeled than a deficit in environmental design. In this view it is not individuals who are retarded, but rather the ability to structure environments which develop and maintain non-retarded behavior. The aim of this review has been to describe the current experimental basis for the design of vocational settings to maintain non-retarded work behaviors of severely and profoundly retarded adults.

Extensive as the research is, it does not yet provide a clear basis for this environmental design, and research on specific environmental effects is clearly needed. It seems unlikely, however, that such research, in and of itself, will result either in the practical environmental design advocated by Lindsley (1964) or in substantial changes in the operation of sheltered workshops. The problem is one of research utilization, and the gap between existing experimental results and current practices in habilitation has long been apparent (Rogers, 1970).

For this reason a more practical line of research is proposed, in which previous results are used to devise useful work supervision systems for applied settings. This is research on how to implement research findings, a problem of engineering, and it will require the same pragmatic efforts which produced the original results. The needed research will be characterized by:

(1) An emphasis on the *practicality of the treatments* employed. In fact, experimental "treatments" will become alternate "supervision methods", each of which must be feasible with typical staff resources in workshop facilities.

(2) An emphasis on the *utility of measurement procedures*. Measures of worker performance are of as much interest to the pragmatic practitioner as the researcher, and measurement methods are needed which can be handled in typical applied settings.

(3) An emphasis on *economic utility* rather than statistical or apparent visual significance of changes in productivity. At issue is not whether a specific supervision method produces a reliable change in work rate, but whether the resulting rate makes continued vocational involvement economically possible.

(4) A simultaneous interest in developing competitive work rates and improving social and personal behaviors. Both are of habilitation interest, and the utility of supervision systems should be evaluated on the basis of concurrent improvement.

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The Effects of a Multiple Schedule of Reinforcement With a Bonus Contingency on Response Rate

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Abstract

This program was designed to increase on task behavior and improve the production rate of a profoundly retarded worker in a subcontract workshop. The worker was a twenty-three year old woman labeled profoundly retarded whose work involved assembly of three-piece electronic components. The treatment procedure involved adding a fixed interval schedule of reinforcement to the existing fixed ratio and thereby allowing the worker to earn bonus incentives. An improvement in both productivity and on task behavior and a reduction in day-to-day variability of both productivity and on task behavior were observed when treatment was begun. Interpretation of this result is difficult, however, because the changes did not reverse when treatment was withdrawn.

The Effects of a Multiple Schedule of Reinforcement With a Bonus Contingency on Response Rate

The effects of instructions, encouragement and reinforcement on response rates of retarded individuals have been widely discussed in professional literature. Behavior rates of both moderately and mildly retarded subjects have been affected by verbal instructions (Evans & Spradlin, 1966; Headrick, 1963) and encouragement (Gordon, O'Connor, & Tizard, 1954; Tizard, 1967). Production rate of moderately retarded people has been increased in other research when a bonus pay contingency was implemented (Hunt & Zimmerman, 1970) and information about results given (Tizard, 1967). A combination of tangible and social reinforcers contributed to longer periods of faster work for a group of noninstitutionalized retarded people (Noonan & Barry, 1967).

This program was designed to use a combination of these previously successful techniques to increase on task behavior and improve the production rate of a severely handicapped person in the Specialized Training Program. In the procedure a fixed interval schedule of reinforcement was added to an existing fixed ratio schedule, and the worker was given the opportunity to earn bonus incentives for her work. Further, the procedure included extensive use of verbal instructions and encouragement procedures similar to those found effective by Gordon, O'Connor and Tizard (1954) and Tizard (1967).

Method

The worker was a twenty-three year old woman who had been diagnosed as being profoundly retarded and schizophrenic. The most recent psychological assessment was a Vineland administered in 1974 which indicated an SQ of 22 and an SA of 4.8. She did, however, have some receptive and expressive language. She had been institutionalized in a state school for the retarded from August, 1966, until October, 1974, when she was placed in the community and included in the Specialized Training Program. The worker had been taught to manufacture heat sinks, small three piece metal units used in circuit board assembly. She knew her task and was capable of working accurately and quickly, but she spent a great deal of time off task, resulting in a poor and erratic production rate. Persistent off task behavior typically consisted of looking at the materials without manipulating them, playing with the materials in a way not designed to manufacture heat sinks, staring into space, engaging in self-stimulation and occasionally tantruming.

Materials and Setting

Work was performed in a production room where thirteen severely and profoundly retarded adults were supervised by two or three program employees. The worker sat at a table facing a rectangular box containing three bins. Each bin contained a supply of one of the parts needed to complete the task. In front of the box was a fixture in which the worker placed the parts for support while she screwed them together. To the left of the fixture was a 5x8 inch card containing twenty marks, on each of which the worker placed a completed heat sink during production.

Data Collection

The dependent variables were off task behavior and production rate. Off task behavior was defined as any activity other than looking directly at the tools and materials, holding and manipulating them in the prescribed manner, placing the completed product in the appropriate place, hand raising to inform the supervisor that the task was completed or that additional parts were needed, or attending to instructions regarding the task.

Off task behavior was recorded by trained observers who watched unobtrusively from behind one way mirrors on an observation deck. The worker's behavior was recorded during 15-second intervals and was considered off task for any interval in which off task behaviors occurred for more than two seconds. The percent of intervals recorded as off task was the dependent variable of interest here. Reliability of observation was determined by random checks by a second experienced coder. The number of intervals in which the two observers agreed was divided by the total number of intervals in each reliability check, yielding an average of 94 percent agreement.

Production rate was indexed by the average number of minutes required each day to complete one heat sink. The exact time each card was begun and ended was recorded immediately by the floor supervisor. At the end of each day the number of heat sinks produced was totaled and divided by the number of minutes worked that day, giving the average time required per heat sink.

Procedure

Baseline. During baseline the worker was on a fixed ratio schedule of reinforcement. Every time she completed one card of twenty heat sinks, she raised her hand to indicate completion and received one penny plus social praise. She could accumulate pennies until the scheduled break when she could exchange these for edibles. She was also on a variable interval schedule of presumed social reinforcement for on task behavior, receiving intermittent praise and touching from production supervisors. Off task behavior was ignored unless the worker was tantruming, in which case she was placed in a time-out area.

Treatment. Treatment consisted of manipulating the independent variable of reinforcement schedule. This was done by changing to a multiple schedule of reinforcement by adding a fixed interval to the existing fixed ratio. A timer was set for the average time the worker had taken to complete one card of twenty heat sinks over the immediately preceding five day period. When the timer was set, the supervisor explained that if the subject completed her task before the bell rang, she would receive two pennies, constituting a one penny

bonus.[1] No mention was made of the fact that if she did not finish before the timer went off, she would receive her usual one penny. Along with instructions, the worker was given much encouragement to "beat the bell" and earn more money to spend at break. The worker continued to receive intermittent social praise contingent on being on task as well as encouragement to finish her card before the timer went off. If the bell rang before she was finished, supervisors ignored the bell. However, if the worker completed her task and raised her hand before the time was up, she was given two pennies, along with a great deal of praise for her success. She was also allowed to turn off the timer so she could hear the bell ring and know that she had, in fact, beaten the bell. When she went to the store the supervisor again praised her for having so much money to spend as a result of working hard.

Results

The effects of the treatment procedure on both production rate and off task behavior are presented in Figure 1. During baseline both behaviors were

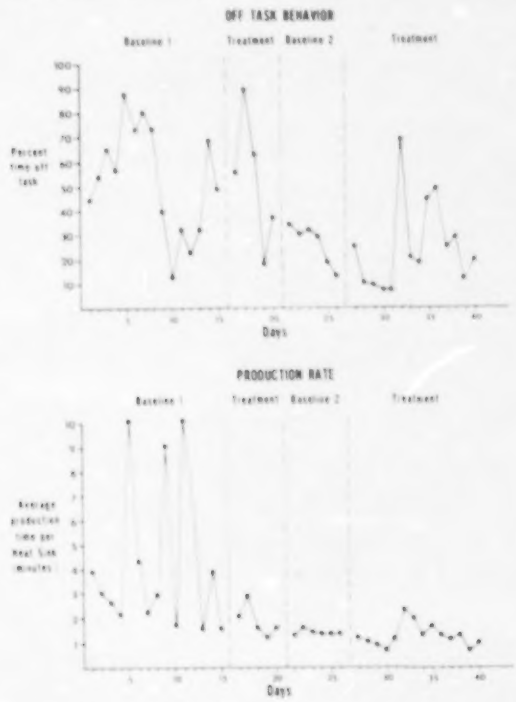

Figure 1

PERCENT TIME OFF TASK AND AVERAGE PRODUCTION TIME DURING BASELINE AND TREATMENT CONDITIONS

[1] Since reinforcement delivery was contingent on emission of a response before termination of the interval, the schedule described here does differ somewhat from the fixed interval schedule described by Ferster and Skinner (1957). The term is used as the most appropriate commonly used label for a schedule of this type. It should be noted that the length of the fixed interval varied from day to day since it was always based on the average of the previous five workdays.

very erratic. The worker spent from 12% to 88% of the time off task and had daily production averages of 1.5 to 9.1 minutes per heat sink. It should be further noted that on two occasions during this period the worker did not complete one card in an entire day. Although no average time could be computed for those days, a measure of 10.1 was assigned for visual clarity in Figure 1. The mean time off task during baseline was 52% and the mean minutes to complete one heat sink was 4.0, excluding data from the two days with zero production.

On the first day under the treatment condition, the percent of time off task was 55 and the production rate was 2.1 minutes per unit. Both increased on day two and then decreased on the remaining three days. During this period the mean time off task remained at 52% but average production time decreased to 2.7 minutes.

In the return to baseline period, there was no increase in either measure. Instead a slight continuing decrease was noted in both. Mean time off task was 26%, and mean production time was 1.4 minutes per heat sink.

When the treatment procedure was implemented for a second time, the production time continued to decrease, and after an increase on the first day, the percent of off task behavior also decreased. The increase in average time on days 32 and 33 is similar to that of other workers on these days. Another worker created a considerable disturbance in the production room at this time, possibly causing the performance decrement. Average time off task during the second treatment condition was 25%, and average production time was 1.3 minutes with little variation.

Discussion

Improvements were observed in both the production rate and off task behavior of a profoundly retarded woman when the defined treatment procedure was implemented. The procedure involved establishing a multiple schedule of monetary reinforcement for task completion, providing presumed social reinforcers for on task behavior, using definitive instructions about expected performance, and encouraging the worker to meet the requirements of the contingency. Individual components had been effective in previous research with mildly and moderately handicapped individuals (Evans & Spradlin, 1966; Hunt & Zimmerman, 1970; Tizard, 1966). This research evaluated their combination with a more severely retarded worker.

Although changes in both the rate and the variability of performance were obtained, it is unclear whether these were caused by the procedures described. Evidence for a causal relationship would have been provided if performance had returned to the initial baseline levels in the return to baseline phase. Since this did not occur, two interpretations are possible. It may be that the observed change is due to variables not specifically controlled here which happened to coincide with the beginning of treatment. No such variables are apparent to the experimenter upon reflection, but the possibility must be acknowledged. Second, the changes may be due to the procedure and may represent a behavior change which was irreversible in this time frame. Kazdin (1973), for example, notes that the use of a return to baseline design is based on the view that behavior changes are transient and therefore reversible. The possibility that some changes can be irreversible is apparent. Sidman (1960) discusses a similar point, noting that irreversibility can result from either incomplete experimental control or an irreversible change in the organism's behavior. Apparent relationships which are irreversible can thus provide useful information, although they must be interpreted with qualification.

The continuing need for improved supervision procedures for this worker is apparent. The change in performance observed during the period reported here is substantial, but the final rate is still only a small percent of the industry established time standard on which piece rates are based. Further changes in treatment procedure will be made until additional improvements are obtained.

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VOCATIONAL ASSESSMENT

The Trainee Performance Sample: Toward the Prediction of Habilitation Costs for Severely Handicapped Adults

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Abstract

Severely handicapped adults have often been excluded from vocational rehabilitation programs because they were not seen as feasible for ultimate occupational success. Recent training and management research has demonstrated that these adults can be quite successful with appropriate training, and a practical basis for selecting and placing them in training programs is needed. For this reason the Trainee Performance Sample (TPS) was developed to predict time required for vocational training. Preliminary data on the TPS indicates high internal consistency reliability and stability of scores over time and trainers. Further, correlations between TPS scores and training time and trials were above .75 in four of seven samples. Although considerably more research is needed, the TPS does appear to be a potentially useful instrument in making client acceptance and placement decisions for severely handicapped adults.

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The Trainee Performance Sample: Toward the Prediction of Habilitation Costs for Severely Handicapped Adults

A rapidly expanding research literature indicates that moderately, severely and profoundly retarded adults can acquire and perform a variety of remunerative vocational skills. This is especially true for work that involves small parts assembly or manipulation, where a veritable technology for vocational training and management has resulted from techniques of behavior shaping, discrimination training and contingency management. Successful vocational training procedures have been described in a number of reports spanning the last two decades (see, for example, Clarke & Heremelin, 1955; Williams, 1967; Tate & Barhoff, 1967; Gold, 1972; Bellamy, Peterson, & Close, 1975). An even more extensive research area indicates that production rates can be improved substantially by careful arrangements of social events in the work environment (for an extensive review of research in modification of work rates, see Bellamy, 1975a).

The compelling conclusion from this research is that most severely handicapped adults could participate effectively in far more vocational opportunities than are usually provided, and that they can earn significant wages performing economically useful work. The discrepancy between this possibility and the current practices of most rehabilitation agencies deserves careful analysis. This report focuses on one area in which the research suggests some new directions, that of vocational evaluation.

From an empirical viewpoint, vocational evaluation has involved attempts to identify personological characteristics which could predict future occupational success of individual adults, either with or without intervening treatment (Neff, 1970). Practically, vocational evaluation has involved the use of tests, which were designed to measure these characteristics, to assist in making feasibility and placement decisions about individual adults. These decisions are reflected in the questions: "Is this person a feasible vocational rehabilitation client, or is it unlikely that he will be able to maintain successful employment?" and "If feasible, what training programs are needed to insure vocational success?".

Critics of the vocational evaluation process frequently cite the lack of strong relationships between scores on available tests and occupational success, and suggest that there is little empirical basis for making feasibility decisions in individual cases (Wolfensberger, 1967; Windle, 1962; Gold, 1973). The recent vocational successes with severely handicapped adults support this criticism. Although these adults typically perform poorly on most evaluation devices, the implication of the research is that they can perform quite well after training. Thus the notion that individual characteristics can be used to determine a severely handicapped person's feasibility for future employment no longer seems useful. The majority of this population now appears "feasible" for eventual occupational success, given specific job areas and appropriate training and management techniques. It does not seem appropriate to exclude them from rehabilitation services because of poor performance on typically used evaluation instruments.

However, neither this rationale nor the successful demonstrations on which it is based is likely to reduce the decisions about individual treatment, placement, or caseload acceptance which vocational rehabilitation counselors and institution administrators must make. Rehabilitation agencies probably will continue to struggle with budgets which are inadequate to provide services to all who could benefit, and selection of specific individuals to receive the available services will be made on some basis. Similarly, institutions for the retarded will still have to select specific individuals for the few available community placements. The constraints on our present habilitation programs are such that these selection decisions will continue to be made, whether or not a solid empirical basis for them is available. Further, individual placement decisions will also be necessary even if improved vocational training programs become available and begin to serve all handicapped individuals. Considerable variability could be reasonably expected in the amount of training which the various programs could afford to provide, and some basis would be needed to assign individuals to these programs.

The continuing necessity to make these kinds of practical decisions motivated the present research. Indeed, the central issue in client acceptance by rehabilitation agencies now appears to be one of *practicality*, not feasibility. That is, in light of the vocational training research, questions concerning client acceptance might be best phrased, "Are treatment and training services available in this community which will produce the desired occupational outcome?", not, "Can this person feasibly attain that outcome?".

The importance of this practicality issue is indicated by the actual decisions facing habilitation professionals, and it is also supported by the results of the successful vocational training and management research. Careful inspection of the data in most reports of vocational training of the severely handicapped reveals rather large individual variability in training time or trials before a criterion is reached (see, for example, Gold, 1972; Gold & Barclay, 1973; Crosson, 1967). Thus, although practically every trainee acquired the defined skills in each study, it is apparent that training was quite expensive for some and relatively rapid for others. If it were possible to predict in advance the relative amount of training that a severely handicapped individual might need, decisions about client acceptance and placement could be made by evaluating the availability of needed training services, rather than by estimating the disabilities of individuals needing the training.

The present research assumes that decisions about individual severely handicapped adults would best be made on the basis of this kind of practicality criterion. The intent of the research is to develop an assessment instrument which predicts time and cost required for teaching industrial assembly skills to severely handicapped adults. This report will describe the Trainee Performance Sample (Bellamy, 1975b) and present preliminary data on its reliability and validity.

Development of the Trainee Performance Sample (TPS)

The TPS was designed to sample the behavior of severely handicapped adults in vocational training situations. It was developed by (1) examining the situations to which an individual would likely be expected to respond in training, (2) combining these situations to define a domain of test items having a specific structure, and (3) selecting specific items from this domain.

Our own training methods and those reported in other research (e.g., Crosson, 1967; Tate & Barhoff, 1967; Gold, 1972) can be viewed as methods of

structuring environmental events so that a chain of manual behaviors is acquired by the trainee. Each element of the chain typically involves manipulating an object in a specific way or assuming a given hand position, and both the onset and termination of these movements must come under the stimulus control of cues which are provided by the task itself. In training, therefore, an individual is expected to learn to perform specific manipulations and to make discriminations necessary for correct and timely performance.

To teach these skills, a trainer typically structures presentation of the task materials, allows the trainee to respond, and then provides either presumed reinforcers or correction procedures after correct and incorrect responses, respectively. Correction procedures are normally designed to give the least necessary assistance to obtain the correct response on an immediately following opportunity (Skinner, 1968), and these may involve either verbal directions, models of the correct response, or physical primes. In each case the amount of assistance given in the correction may be varied by providing either specific information (e.g., "The flat side goes up.") or quite non-specific information (e.g., "Try again.").

A person for whom training is likely to be efficient would therefore appear to be one who has learned to attend to typically used correction procedures and for whom these procedures have become effective cues for subsequent behaviors. Similarly, one who persists in correct responding after receiving apparently pleasant consequences would likely learn more quickly than one who does not.

This rationale provided the basis for defining the item domain of the instrument. Specifically, items were structured so that each would:

(1) require the individual to make a specific object manipulation or assume a defined hand position;
(2) require that this movement be performed after a specifically defined trainer cue, involving a verbal direction and either a model or physical prime;
(3) necessitate that the individual make a defined discrimination to complete the movement correctly;
(4) allow the individual to respond a second time to the same task, immediately following a repetition of the trainer cue if the first task was incorrect and a presumed reinforcer if the first attempt was correct.

In its present form the TPS is comprised of thirty items selected from the domain of possible items having these characteristics. Sample items are presented in Table 1. An individual can score 0, 1 or 2 on each item, reflecting the number of correct responses to the two opportunities. The score for the entire test is the sum of those for all items, and thus can range from 0-60.

Item Analysis

The initial research on the TPS was designed to determine whether the test items had indeed been sampled from a single domain, and thus measured a unitary or cohesive set of characteristics. To perform the item analysis the 30-item test was administered to 305 severely retarded adult residents of the Fairview Hospital and Training Center in Salem, Oregon. The most recent psychological evaluation was used to define a population which was severely retarded, able to see and hear functionally, and which appeared to have normal use of both hands. Subjects were selected randomly from this group.

The test was administered by a graduate student research assistant at the University of Oregon. Testing was conducted during weekly visits from

Table 1

SAMPLE ITEMS FROM TRAINEE PERFORMANCE SAMPLE

Setting	Completion	Score
4. Three nuts and bolts. Bolts have a red section in the middle of each bolt. Nut is at top of bolt. Say "WATCH-DO THIS". Turn nut down towards red section. While turning say "GOOD". Stop turning, point to red, say "TRY AGAIN". Continue turning until red is covered. Say GOOD-YOU TRY. Hand bolt to S.		
14. Three large bearings on table with flat side up. Say "DO THIS". Place thumb and index finger of S around bearing and turn bearing over. Say "NOW YOU DO IT". Score correct if S turns bearing over.		
30. No Materials. Say "WATCH . DO THIS". Extend both index fingers and touch tips. Say "NOW YOU TRY". Score correct if S touches index fingers at tips. model		

October, 1974 to May, 1975, with an average of ten subjects per visit. A small enclosed room was available in each subject's residence hall, and this allowed for administration of the test without interruption from staff or other residents. Actual administration took approximately ten to thirty minutes, with differences being primarily due to cooperation and apparent ability of the subjects. A variety of small edibles and complimentary comments were used as presumed reinforcers after each correct response made by the trainee.

Most subjects were extremely cooperative and appeared anxious to interact with the test materials. The tester used brief exposure to the materials, verbal encouragement, and reinforcement sampling procedures to induce initially recalcitrant subjects to participate. This was effective in all but three cases, and these individuals were dropped from the study.

Test scores in the sample averaged 30.80 out of a possible score of 60.0, with a standard deviation of 17.60. Item-test correlations ranged from .45 to .82

with a mean of .68. The coefficient alpha of .961 suggests that the existing 30 items are indeed sampled from a single domain. Because of the relative ease of administration in the original form, no attempt was made to reduce the number of items.

Stability of TPS Scores Across Time and Testers

The purpose of the Trainee Performance Sample is to predict the time needed for vocational training, providing a basis for decisions about individual acceptance or placement in vocational training programs. Decisions which could eventually be made on the basis of the test would be effective for the duration of a training program. It thus seems appropriate to ask whether scores on the TPS are stable over a time period of several months, rather than just the two to four weeks typically recommended for estimating test-retest reliability (Standards for Education and Psychological Tests, 1974). Readministration of the same test, rather than a parallel form, was judged appropriate, inasmuch as ability level of the subjects and the long time elapse between tests seemed to preclude the possibility that memory would be a systematic source of variance in test scores.

The stability of the test scores across time and across testers was assessed by randomly selecting 50 of the 305 subjects for readministration of the test by a different research assistant after a period of five to twelve months. Individuals who had received vocational training from our project during the intervening period were eliminated from the retest sample. Comparison of the two sets of test scores are presented in Table 2. As is apparent in the table, the random

Table 2

COMPARISON OF SCORES OF ORIGINAL TEST SAMPLE WITH THOSE OF FIRST AND SECOND ADMINISTRATIONS ON RANDOMLY SELECTED SUB-SAMPLE OF 50 SUBJECTS

	Original Sample	Subsample: First Administration*	Subsample: Second Administration*
Mean	30.80	32.96	38.70
Standard Deviation	17.60	16.63	14.98

*Stability coefficient is .91; mean difference between first and second administration is significant at the .01 level.

sample of 50 subjects was fairly representative of the larger group in the initial administration of the test. On the second administration, scores were significantly higher ($p<.01$), but overall variance appears similar. The test-retest reliability coefficient is .91, indicating considerable stability of score ranks across time and across testers for the subject sample. Subsequent research will assess the generalizability of these reliability results to other severely handicapped populations.

Validity Studies

The usefulness of the Trainee Performance Sample will depend on the extent to which predictive relationships can be identified between test scores and

relevant parameters of vocational training. That is, an empirical basis for using the TPS in practical decision making will exist only if strong relationships can be identified between test scores and such criteria as time, trials or cost required for vocational training.

Three predictive validity studies have been conducted to date with residents of the Fairview Hospital and Training Center. In each of these a specifically defined group of adults was tested with the TPS and then given individual training on a vocational task similar to current subcontracts in the State's workshops. Trainers were not informed of subject's test performance. In each study the relative efficiency of alternate training techniques for each task was also assessed by randomly assigning subjects to various training conditions. As a result, correlations were obtained between the TPS and required training time or trials for three separate work tasks and a total of seven different training programs.

In the first of these studies, adult residents of selected dormitories who were labeled severely retarded on the basis of the most recent intellectual or social assessment were defined as the population pool from which trainees were randomly selected. As can be seen in Table 3, this selection procedure resulted in a sample whose TPS scores were somewhat higher than those of the original sample. Each of the subjects learned to assemble an 11-piece cam switch subassembly similar to that described by Bellamy, Peterson and Close (1975). Trainees were randomly assigned to one of two training conditions, a large step forward chaining procedure similar to that described by Gold (1972) and a small step forward chaining procedure like that used by Crosson (1967). Training continued in each case until a criterion of two consecutive errorless assemblies, and training time required before this criterion was the dependent variable of interest. Variability between subjects was high, and the two procedures appeared to have similar efficiency. Because of the procedural differences they are considered here as separate samples in determining the relationship between training time and TPS scores.

In the second study subjects were selected in the same way to assess the relative efficiency of forward and reverse chaining procedures in teaching a three-piece heat sink assembly. Training time before a criterion of two consecutive perfect assemblies was again of interest. The two procedures appeared about equally effective in teaching the task, and as with the cam switch, they are reported here as separate samples in determining the relationship between TPS scores and training time.

The third study was conducted by Irvin (1975) to assess the relative efficiency of alternate attention engineering strategies in teaching a difficult visual discrimination. Moderately and severely retarded adults who passed a simple manual pretest were assigned randomly to one of three training conditions: (1) addition and fading redundant color cues (AFRC), (2) addition and removal of large cue differences (ARLCD), and (3) a combination of the two procedures (AFRC ARLCD). In each condition subjects learned to place a hex nut on a bicycle axle with the slightly raised face of the nut facing upwards. Training continued until a criterion of 25 consecutive correct discriminations, and the number of trials before reaching this criterion was the dependent variable. Results of the training study are presented in Irvin (1975), so the present discussion will be limited the relationship between TPS scores and trials to criterion in each of the three conditions. A total of nine subjects in the three samples did not reach criterion in 600 teaching trials, and these were assigned a maximum score of 700 trials for correlations with TPS scores.

The relationship between TPS scores and the training performance of sub-

jects in each of these studies is summarized in Table 3. Although individual samples are relatively small, correlations are consistently high. More than 50

Table 3

CORRELATIONS BETWEEN TPS SCORES AND TRAINING TIME AND TRIALS

Task learned	Sample size	Training time, average	Training time, standard deviation	TPS score, average	TPS score, standard deviation	Correlation
11-piece cam switch assembly, small step training procedure	14	414.6 min	319.2 min	45.3	7.0	−.81*
11-piece cam switch assembly, large step training procedure	9	432.1 min	200.1 min	46.3	10.6	−.78*
3-piece heat sink assembly, forward chaining procedure	10	56.2 min	51.3 min	41.9	10.1	−.76*
3-piece heat sink assembly, reverse chaining procedure	11	71.5 min	57.1 min	45.0	7.7	−.21
Bicycle hub nut discrimination, AFRC procedure	21	162.0 trials	166.4 min	39.5	14.3	−.48*
Bicycle hub nut discrimination, ARLCD procedure	26	298.5 trials	237.6	35.5	14.5	−.72*
Bicycle hub nut discrimination, AFRC/ARLCD procedure	20	185.2 trials	180.2	34.5	14.4	−.67*

*$p < .05$

percent of the variance in training time and trials was accounted for in four of the seven samples.

These preliminary data thus suggest that the TPS may be a useful predictor of vocational training needs. Three separate tasks and seven different training procedures have been used in obtaining the validity coefficients represented here. Continued research is needed to determine the extent to which these findings can be generalized to other groups of trainees, other tasks, and other training procedures.

Discussion

Many of the innovations in services for the severely handicapped have resulted not from advances in assessments but rather from attempts to serve individuals who had been previously excluded because of poor assessment results. The overall research program of which these studies are a part is dedicated to "finding methods" to provide needed services to all severely handicapped individuals, rather than "finding individuals" who seem to benefit from a particular type of service. Nevertheless, from a practical perspective, it is apparent that client selection and placement decisions are now made and likely will continue to be necessary, regardless of advancements in service technologies.

The Trainee Performance Sample has been developed to provide an empirical basis for using a practicality, rather than a feasibility, criterion in making client acceptance and placement decisions about severely handicapped adults. The preliminary results reported here suggest that it may indeed be possible to predict the time and therefore the cost of vocational training which will be needed by these individuals.

Research conducted to date with the TPS suggests that it is composed of a cohesive set of items with relatively high internal consistency reliability and stability over time. Further, very close relationships between TPS scores and needed training are apparent in four of seven samples in our vocational training research. Of course, considerably more research is needed before the utility of the instrument is established. Our present research will determine relationships between TPS scores and other tests, and will evaluate the generalizability and validity coefficients across trainers, across vocational tasks, and across other groups of severely handicapped trainees. Of special concern will be the utility of the TPS in predicting training needs when methods other than those used in our research program are employed.

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DOMESTIC LIVING

Community Living for Severely and Profoundly Retarded Adults: A Group Home Study

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Abstract

Severely and profoundly retarded institutionalized adults are studied in a group home setting. Program philosophy, training procedure, and evaluation methods are described. Information on self-help and social skill acquisition is presented. Results show a significant difference in skill acquisition from the experimental group compared to an institutional control group. The results are discussed in light of the current normalization and deinstitutionalization movement. Recommendations for further research in habilitation, social skill training and maintenance, program evaluation, program cost and subject attitudes are presented.

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Community Living for Severely and Profoundly Retarded Adults: A Group Home Study

The task of educating severely and profoundly retarded persons remains the responsibility of a few members of society. The history of institutional care for retarded persons in America has witnessed a full cycle of optimism (Seguin, 1907) and pessimism (Blatt & Kaplan, 1966; Thurman & Thiele, 1973; Wolfensberger, 1972). The original idealism of Itard and Seguin and their belief that mental retardation could be "cured" through "training" has deteriorated to such a degree that the resulting institutional models are being seriously criticized (Wolfensberger, 1971).

The literature on community care for the retarded is void of studies on the community adjustment of severely and profoundly retarded adults. Eagle (1967), in a review of post-institutional research,, reports only 3.3% of the institutional subjects successfully placed in community programs between 1918 and 1960 had measured IQ's below 25. McCarver and Craig (1974) note that a restricted range of intelligence (i.e., in the mild or moderate range of retardation) is used in reporting the relationship between intellectual level and community adjustment.

Recent data shows that 200,000 persons reside in state institutions for the mentally retarded (U.S. Department of Health, Education and Welfare, 1972) and that 82% of these individuals are functioning below the mildly retarded level of intelligence (Klaber, 1969). Eyman, O'Connor, Tarjan, and Justice (1972) report that there is a high probability anyone with an IQ below 50 will be institutionalized at some point in their life. O'Connor (1976) states that nearly all severely retarded persons have life-long dependency; thus, some form of publicly supported residential care becomes necessary.

Studies on community adjustment of mildly retarded persons have identified several important variables which contribute to successful community placement: quality of the living environment (Clark, Kevitz, & Rosen, 1968; Edgerton, 1967; Rosen, 1967), successful work placement (Gold, 1972; Kolstoe, 1961), use of leisure time (Justice, Bradley, & O'Connor, 1971; Kraus, 1972), basic skill acquisition (Bensburg, Colwell, & Cassel, 1965; Eyman, Tarjan, & Cassady, 1970), social skill competence (Kolstoe & Shafter, 1961; Rosen, 1967), and community acceptance (O'Connor, 1976). These studies provide support to the notion of success in post-institutional community placement, but little is actually known about the life styles of persons residing in the community (Bjaanes & Butler, 1974). We also know very little about what it means to be retarded, to live in a large institution, and return to live in a community facility. In sum, there is little empirical basis to tell us whether living in a small community facility is qualitatively superior to life in an institution.

The present research investigated certain factors of the community adjustment of adults classified as severely and profoundly retarded. Targeted habilitation factors included: (a) the acquisition of self-care skills (i.e., eating, toileting, grooming and hygiene) and (b) the performance of social skills (i.e. social interaction, and the elimination of self-stimulatory behaviors) in a group home setting. The purpose of the study is to evaluate post-institutional community adjustment with severely and profoundly retarded adults.

Method

Subjects

Subjects in the present study were 15 severely and profoundly retarded adults (8 men and 7 women). Social quotients from the Vineland Social Maturity Scale ranged from 10 to28 (mean = 16). The average chronological age was 26 years (range 21 years to 39 years) with an average length of institutionalization of 18 years (range 34 years to 9 years). All persons were residents from three units at an Oregon residential institution for the mentally retarded. Selection criteria included: (a) institutional admission from Lane County, Oregon; (b) parent residing in Lane County, Oregon, (c) classification of severe or profound retardation (determined by Social Quotient from most recent Vineland Social Maturity Scale); (d) ability to ambulate without prosthesis; (e) ability to eat with a spoon; (f) less than one uncontrolled seizure per month for the previous year; and (g) a minimum chronological age of 18 years. Eight members (4 male, 4 female) of this group were randomly selected for placement in a community vocational program and group home, while the remaining seven persons (4 males, 3 females) continued to receive the normal treatment provided by the state institution. A one year time period is documented in the present paper. The project described is on-going and is functioning as a coordinated research and service program in Lane County.

Living Environment

The group home is located in a residential neighborhood, zoned in a multiple-family dwelling classification, in Eugene, Oregon. The house had previously been occupied by a group of university students, and contained 6 bedrooms, a large living room and dining room, a large kitchen, 3 complete bathrooms, a recreation room, laundry room, front yard and fenced backyard.

Each person living in the home shares a room with one other person. The group eats all meals together "family" style (versus cafeteria style). All persons work in a local subcontract shop employing severely and profoundly retarded adults.

Staff

The staff of the group home consists of one program coordinator, one house manager, one night manager, four part-time basic skills teachers, and one weekend activity coordinator.

The program coordinator's responsibility is to secure funding for the program, hire and train staff, develop individual programs for each resident, supervise training programs, collect and analyse data, and develop and maintain community contacts. It is the house manager's responsibility to supervise the daily living functions of the home including: meal-preparation, shopping, housekeeping, laundry, and gardening. The night manager sleeps in the house during the night hours (10:00 p.m. until 7:00 a.m.) and conducts regularly scheduled fire drills. The skills teachers teach self-help and domestic skills, and the weekend activity coordinator schedules community outings and recreational programs for the residents. The staffing pattern was supplemented with college work-study students, college practicum students and community volunteers. Total volunteer hours were approximately 75 hours per week.

In the judgment of the program coordinator, the staff are sensitive, honest, hard-working, affectionate people who desire to individually relate to the

residents of the home. The staff are from varied backgrounds, with only the program coordinator having any formal experience working with retarded persons in a group home setting.

Program Characteristics

The program philosophy was consistent with the principle of normalization. Wolfensberger (1972) states the principle as using "means which are culturally normative as possible, in order to establish and/or maintain personal behaviors and characteristics which are as culturally normative as possible." (p. 28)

The persons selected for community placement were phased into the group home in groups of four; one group per month for two months. A daily schedule similar to institutional routine, e.g., same wake up time, meal-times, snack times, medication schedule, bed-times, etc., was followed when possible for the first two weeks in the community. During this two-week period self-help skill, domestic skill and social skill baseline data was collected. Initial training priorities included: toilet training, dressing, bathing, toothbrushing, hair care, shaving, eating (chewing), and elimination of aggressive behavior (hitting and kicking). Individual programs were written for each resident based on baseline information collected by skill trainers during the first two weeks.

Training Procedures

Previous reports indicate that highly structured training procedures have been successfully used to teach self-help skills (Azrin & Foxx, 1972; Bensburg, Colwell, & Cassel, 1965; Minge & Ball, 1967), and leisure skills (Golden, 1974) to severely and profoundly retarded persons. The bases for these procedures are a task-analytic approach to structuring the training program (Bijou, 1970; Gold, 1972), the use of reinforcement contingencies for correct performance (Martin & Lowther, 1972) and the use of overcorrection procedures for errors (Azrin & Foxx, 1971). The training procedures utilized in this study represent a synthesis of task analysis, and sequential training techniques, contingency management, and overcorrection procedures.

Evaluation Procedures

Self-help skill data was collected using the Developmental Record (Hutton & Talkington, 1974). Pre-test information was collected by institutional staff. Post-test information was collected by a graduate student unacquainted with either control or experimental groups. The major purpose of this instrument is to identify training and program needs for retarded persons. The scale was used in the present study to assess behavioral changes as viewed by institutional and group home staff. Observational information was collected by a skill trainer using the Community Living Observational System (Taylor & Close, 1976). Inter-rater reliability was obtained on 20% of the data and averaged 94% agreement (88-100). A standard calibrator approach was used to compute the reliability in which agreements between independent observers are divided by agreements plus disagreements. This coding system was designed to record the sequential interactions of severely and profoundly retarded adults in a group home setting. The code specifically focuses upon unstructured leisure periods and targets all behaviors and interactions which may occur during these times.

Results

Complete data were collected for 12 subjects. One subject (experimental group) was returned to the institution for aggressive behavior after 10 weeks in the community and was dropped from the project. Another subject (experimental group) died after 10 months in the community. A third subject (control group) was placed in the group home after 10 months. The last two subjects supplied no data for the study. Data from each group were summarized for self-care skills, i.e., eating behavior, toileting, and personal hygiene; and social skills, i.e., social interaction, and self-stimulation.

Means and standard deviations were computed for each dependent measure. Pre-test student t-values for experimental and control groups were computed for self-care skills and found to be non-significant at .05 level. Post-test t-values for experimental and control groups showed the experimental group significantly higher. (See Table 1.)

Table 1

DATA FOR SELF-CARE SKILLS, I.E., EATING, TOILETING AND PERSONAL HYGIENE FOR CONTROL AND EXPERIMENTAL GROUPS. PRE-TEST AND POST-TEST MEANS, STANDARD DEVIATIONS, AND T-SCORES ARE REPORTED

Control[a]

Eating[b]			Toileting[b]			Hygiene[b]		
Pre	Post	G/S	Pre	Post	G/S	Pre	Post	G/S
3	4	−2	4	5	−1	2	3	−1
5	4	+1	5	4	+1	3	3	0
4	4	0	5	5	0	3	3	0
4	5	−1	5	4	+1	2	3	−1
4	4	0	2	2	0	1	1	0
4	5	−1	6	5	+1	4	4	0
$\bar{X}$ = 4.0	4.5	−.5	$\bar{X}$ = 4.5	4.2	.33	$\bar{X}$ = 2.5	2.8	−.33
S = .63	.55	1.05	S = 1.4	1.2	.82	S = 1.05	.98	.52
t = 3.61			t = 3.07			t = 4.49		

Experimental[a]

Eating[b]			Toileting[b]			Hygiene[b]		
Pre	Post	G/S	Pre	Post	G/S	Pre	Post	G/S
5	8	−3	5	5	0	2	5	−3
4	7	−3	5	6	−1	1	5	−4
5	8	−3	4	8	−4	3	7	−4
5	6	−1	4	5	−1	3	5	−2
4	6	−2	3	5	−2	4	5	−1
4	8	−4	4	8	−4	1	6	−5
$\bar{X}$ = 4.5	7.2	2.67	$\bar{X}$ = 4.2	6.1	−2.00	$\bar{X}$ = 2.3	5.5	−3.17
S = .55	.98	1.03	S = .75	1.5	1.67	S = 1.2	.84	1.47

a= N = 6 in each group
b = In developmental stages of learning
G/S = gain scores

The following t-values were computed: eating, 3.61, $p<.01$, toileting, 3.07,

$p<.02$, grooming, 4.49, $p<.01$. The omega squared (ω^2) value is the best estimate of the portion of variance accounted for by the training procedures (Hayes, 1973). Omega squared values for the dependent measures are as follows: (a) eating = 41%, (b) toileting = 50%, (c) personal hygiene = 61%.

Means and standard deviations were also computed for each social skill measure. The t-values are presented as log scores due to a linear dependence of means and standard deviations in both groups. Log transformations of rate and observational data are common, and did not materially affect significance levels. Six-month values are presented due to an inability to collect baseline observational data while the experimental group still resided in the institution. Random selection and assignment allows the argument for no difference between groups. Six-month t-values (presented in log scores) revealed a significant relationship in favor of the experimental group. The following t-values were computed: social interaction, 2.39, $p<.05$, $\omega^2 = 28\%$, self-stimulation, 2.06, $p<.05$, $\omega^2 = 21\%$. (See Table 2.)

Table 2

DATA FOR SOCIAL SKILLS, I.E., SOCIAL INTERACTION AND SELF-STIMULATION FOR CONTROL AND EXPERIMENTAL GROUPS. SIX MONTHS DATA COLLECTED FOR EACH GROUP. MEAN, STANDARD DEVIATIONS, AND T-SCORES REPORTED

6 months

Social Interaction[a]		Self-Stimulation[a]	
Control[b]	Experimental[b]	Control[b]	Experimental[b]
0	.40	3.0	.05
0	.50	5.3	0
0	.58	5.1	.33
.04	.83	0	.04
.36	1.30	6.7	0
.47	0	.2	3.5
$\bar{X}$ = .15[c]	.63[c]	$\bar{X}$ = 3.4[c]	.47[c]
S = .21[c]	.32[c]	S = 2.8[c]	.47[c]
t = 2.39		t = 2.10	

a In rate-per-minute
b N = 7 in each group
c In obtained scores
(t-values computed in log scores)

Discussion

The finding that living in a community-based living arrangement facilitates acquisition of self-care skills and performance of social skills of severely and profoundly retarded adults is encouraging. Other researchers have reported similar results in studies of vocational skill acquisition (Bellamy, Peterson, & Close, 1975; Gold, 1972) and language acquisition (Guess, Sailor, & Baer, 1974).

If the deinstitutionalization movement is to succeed, it must be implemented on sound empirical, programmatic and humanistic principles. Much more knowledge is needed in areas critical to facilitating and maintaining the community adjustment of retarded persons. Information is needed concerning the

characteristics of persons having the highest probability of success in the community. Information on training procedures that efficiently teach complex social and community skills is needed. Information on the behavioral characteristics of staff persons who supervise and teach retarded adults is needed. Training programs for professionals and para-professionals need to be developed. Research on the issues of generalization from training settings (home, school, workshop) to the general community is needed. Detailed information on the cost of community living facilities is needed. Additional work in refining evaluative methods for assessing individual and program success is needed. Finally, more information is needed concerning how the retarded feel about community living. What is a quality life and how do you measure it?

A cautionary note must be expressed in equating the success of this program to a mere change from institutional living to community living. O'Connor (1976) reports that only 69% of the community residential facilities she sampled were normalized, i.e., provided patterns and conditions of daily livng which appeared culturally normative to raters. She concludes that the placement of persons into small community residential facilities does not assure that the resident will automatically have a normal life. The specialized environment needed to produce increases in self-care and social skill competence may be accomplished through a positive philosophy, individualized skill training programs, consistent behavior management procedures, and sophisticated evaluative instruments. The project also had some methodological limitations. The use of the Vineland Social Maturity Scale Quotient (SQ) is not desirable for adult persons. The scale is administered by institutional staff to all residents and provided a standard measure for group selection. The persons administering the Developmental Record and observation devices had knowledge of group assignment due to the fact that the scale used required the reports of both institutional and group home staff. This could possibly contribute to a results bias. The specific program components related to the observed changes cannot be specified in detail from the present data.

The project described in this paper is an attempt by a group of dedicated persons who believe that community living can be a viable alternative for institutionalized severely and profoundly retarded adults. The commitment is intensive, the work difficult, and the rewards great. A group of persons who have resided in institutions a majority of their lives now have an opportunity to return to their families and community and gain competence and respect in the process. This is a beginning to studying severely retarded, institutionalized persons. They are resourceful, sensitive and striving. Like all of us, in our unique ways, they have made a place for themselves in a human community.

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Picture Recipe Cards as an Approach to Teaching Severely Retarded Adults to Cook

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Abstract

Picture-only recipe cards were used to teach three severely retarded adults to cook hot dogs, hot chocolate, and Jello. Training was done individually in a fully equipped kitchen. All trainees learned to follow each of the recipes. Evidence for the development of a generalized skill of following picture recipes was provided by decrease in training time and trials required to learn successive recipes and by increases in the percent of steps performed correctly on the first trial on new recipes.

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Picture Recipe Cards as an Approach to Teaching Severely Retarded Adults to Cook

An increasing number of severely and profoundly retarded adults are being placed outside the large institutions. It is likely that they will have the opportunity to participate in group living situations and sheltered work programs. However, both the economy of these programs and the quality of life in them will depend in part on the community living skills which the individual adults acquire. A number of programs are available for teaching self-help (Bensberg, Colwell, & Cassel, 1965; Hamre, 1974), academic (Oregon Mental Health Division, 1971-72; Brown, Williams, & Crowner, 1974), and some community living skills (Fredricks, Heyer, Alrick, & Bunse, in preparation; Certo, Schwartz, & Brown, 1975).

In this paper an instructional program is presented for a particularly important community living skill, that of food preparation. If severely retarded adults could cook safely, the range of independent activities available to them in the house would be greatly increased. Further, their ability to participate in daily chores would be enhanced, easing some of the responsibilities of the home provider.

Several cookbooks are available for individuals without sophisticated academic skills. Those written for elementary-age children include Better Homes and Gardens (1972), Betty Crocker (1975), Moore (1969), Parents Nursery School (1974) and Sedgwick (1967). Independent use of these books typically requires a third or fourth grade reading level. Measurement and appliance use skills are also needed. Illustrations are provided to clarify specific steps and add visual interest to the recipes. Fewer academic skills are needed to use a few picture recipe books that were written for trainable level children. These include Kahan's *Cooking Activities for the Retarded Child* (1974), Steed's *A Special Picture Cookbook* (1974), and Yates' *Look and Cook* (1972). Rather extensive picture illustrations are provided in these cookbooks, but several prerequisite skills are still needed. To use these recipes independently, for example, an individual would need number recognition skills and a sight word vocabulary. In addition, the illustrations provided often require the individual to perform a series of steps in response to one picture, without specific cues for each step.

It seems likely that severely retarded adults could learn many of the prerequisite skills needed in these recipes. However, if some cooking skills can be developed without these prerequisites, a severely retarded person might participate sooner in daily food preparation activities.

The program described here was designed to develop a recipe system which would allow independent cooking with minimal prerequisite skills. To be effective, such a recipe system must: (1) illustrate cooking steps without relying on reading skills, (2) make discriminations in measurement and temperature as easy as possible, (3) use a standardized set of symbols so that after training, an individual could prepare a novel food item without assistance beyond the recipe.

The recipe system developed for this program relied on the use of illustrative pictures for each preparation step and color coding of temperature controls and measurement instruments. Whether this recipe system will allow individuals to prepare novel food items independently is the question addressed here. Evidence for the development of this generalized skill will be provided if trainees' performance on successive recipes reveals decreases in trials and training time to criterion and increases in the percent of steps performed correctly on the first trial on new recipes.

Method

Trainees

Three adults labeled severely retarded were selected for participation. They had previously been placed from large institutions into a community group home and sub-contract shop. Each was chosen because of an interest in learning to cook, as indicated by willingness to help in the group home kitchen and by expressions of desire to learn to cook. All the trainees could follow simple verbal directions. None had used picture recipes before, and none could prepare the recipes chosen for this training. The following information was obtained from official hospital records.

Trainee 1. Female; age 21-2; Vineland Social Quotient 25 (1974); AAMD classification: Severe adaptive retardation due to Down's Syndrome; no expressive language.

Trainee 2. Male; age 28-9; Vineland Social Quotient 34 (1974); AAMD classification: Moderate mental retardation following psychiatric disorder; hospital report functioning in moderately to severely retarded range.

Trainee 3. Female; age 25-4; Stanford Binet IQ: 14 (1972); AAMD classification: Profound mental retardation due to Down's Syndrome.

Materials

Picture recipes were written for Jello, hot dogs and hot chocolate (Table 1). These were selected because they were similar in subjective food appeal

Table 1

A COMPARISON OF THE ILLUSTRATED AND TASK STEPS IN THE RECIPES TAUGHT

Recipe		Illustrated Steps	Task Analysis Steps
Hot Chocolate	(HC)	24	62
Jello	(J)	27	67
Hot Dogs	(HD)	29	61

and involved approximately the same number of task analysis steps. Picture illustrations and pre-preparation steps were also similar. The pictures were drawn on 5x8 inch cards which were joined together by two rings at the top. The first card was a large color picture of the finished product. Below the picture was the name of the food. The next card has a picture list of the food ingredients and cooking and eating equipment that were to be set out. The following cards contained the recipe, three steps per card. Each step was sep-

arated by a line. The procedure and equipment illustrations were in black and white, with the exception of the color coding described below. All the food products were in their natural colors. The cards were pastic coated and had a wood stand to hold them in an upright position. The recipe cards for hot dog preparation are shown in Figure 1.

Figure 1

THE PICTURE RECIPE FOR HOT DOGS. IN THE ACTUAL RECIPE, THE FOOD AND BURNERS ARE COLORED

Other special equipment included range burners and measuring utensils, color coded with plastic tape. Each dial was associated with the burner it regulated by a piece of tape of a specific shape. A portable kitchen timer was available with the numbers 0 through 20 showing. The training was done in a fully equipped kitchen during working hours. Data was kept on each trial by use of a detailed task analysis as the data sheet.

Procedure

Training was conducted two to three times a week in sessions which lasted approximately 40 minutes. During a session, a trainee completed one recipe with individual instruction from the author or one assistant. During training, the trainee was expected to perform each step in the recipe independently. The instructor intervened only to provide assistance after an incorrect step or to compliment correct performance.

Performance on the recipe steps was recorded as correct (done without help or with non-specific verbal cues such as, "What's next?") or incorrect (completed only after specific instructor assistance). The trainees were required to follow the exact sequence of steps only when it was essential for successive preparation of the recipe. The steps which had to be performed in order were noted on the task analysis data sheet.

The time required to complete each trial was also recorded with a stopwatch. Training continued on each recipe until a criterion of one correct trial was attained. A trial was considered correct when all steps were completed with neither specific nor non-specific cues from the trainer. Because of persistent performance problems with Trainees I and II, however, failure to complete non-critical steps previously performed correctly did not prevent criterion attainment. These steps included washing hands and remembering to wash dishes.

The three recipes were taught in a different sequence to each of the three trainees. Instructor assistance consisted primarily of teaching recognition of symbols for food, equipment, and manipulations, how to "read" the cards, and manipulation skills that the trainee did not know.

Results and Discussion

Each of the three trainees learned to prepare all three recipes in the instructional program. Figure 2 illustrates the percent of steps which were performed correctly during each trial. A gradual increase in the percent of correct steps across trials for each recipe is apparent for all trainees, with the initial recipe requiring more trials in each case before criterion performance.

A question of particular interest is whether individual adults will be able to use the recipe system to prepare novel food items independently after training is completed. Evidence related to this issue is presented in Figure 3 and includes data on: (1) decrease in training trials required before criterion performance was attained on successive recipes, (2) decrease in training time required on successive recipes, and (3) percent of steps performed correctly on the first exposure to each recipe.

The number of trials required by each trainee to reach criterion on the three recipes supports the utility of the recipe system in developing a generalized skill of following recipes. Each of the three trainees required fewer trials on both the second and third recipes than on the first, and one required still fewer trials on the third recipe. A similar result is apparent in the total time required by the trainees before reaching criterion on the three recipes. Again,

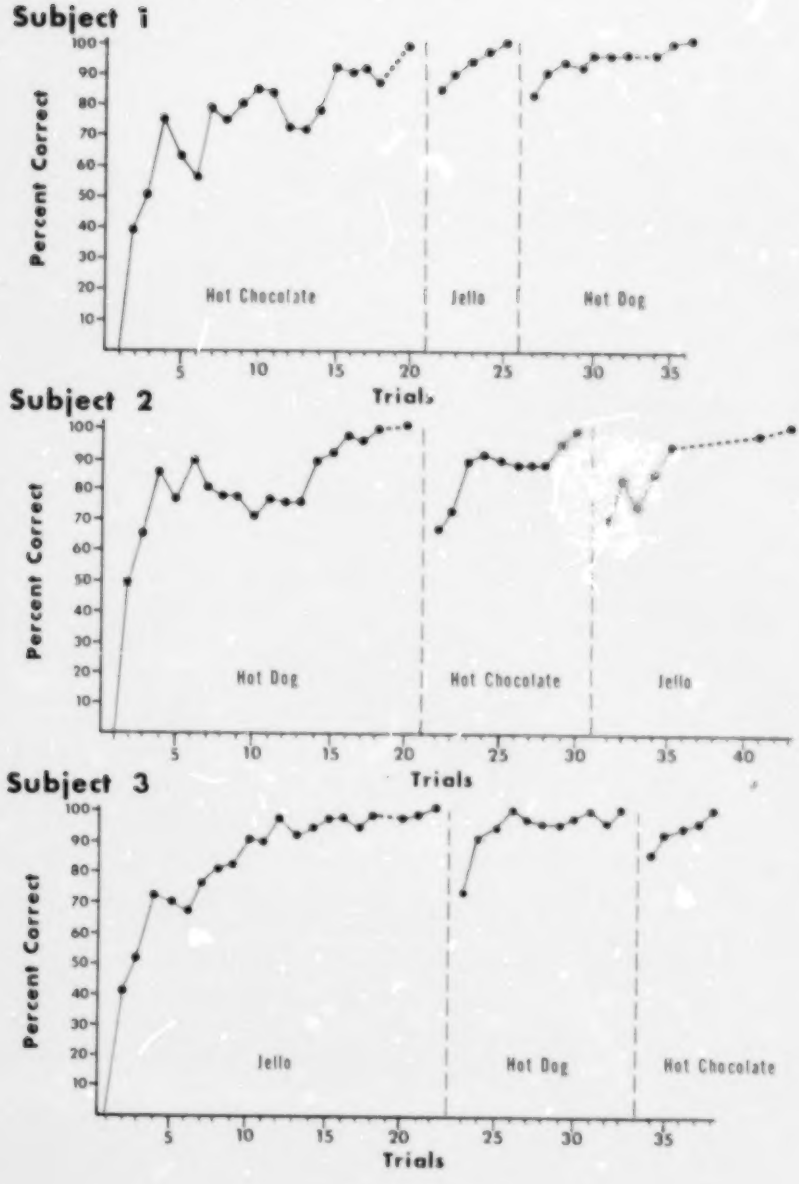

Figure 2

PERCENT OF STEPS IN EACH RECIPE PERFORMED CORRECTLY BY THE THREE TRAINEES ACROSS TRIALS

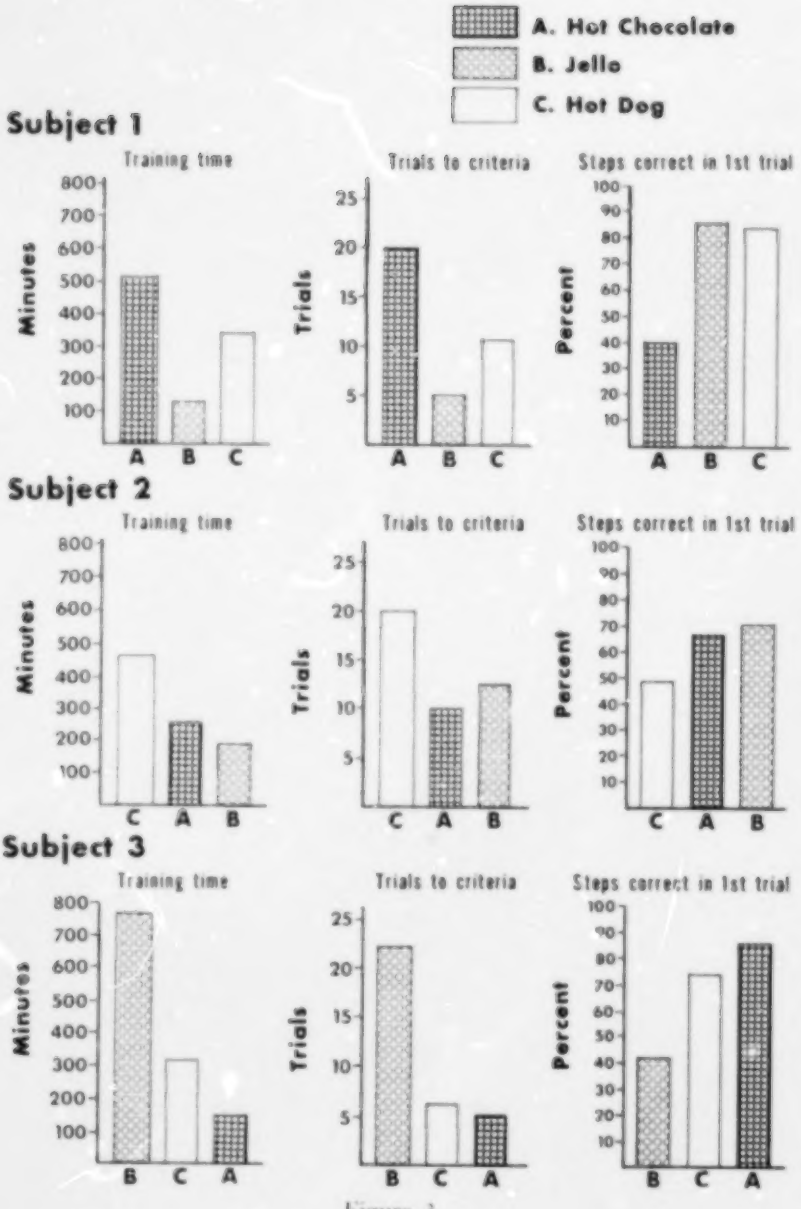

Figure 3

NUMBER OF TRIALS TO CRITERION, TRAINING TIME BEFORE CRITERION, AND PERCENT OF STEPS CORRECT ON THE FIRST TRIAL FOR EACH OF THREE TRAINEES ON SUCCESSIVE RECIPES

all three required less time on the last two recipes than on the first, and two required less time on the third than the second recipe. Of course this reduction in time and trials to criterion could indicate either the development of a generalized skill of following recipes or an increase in the ability of the instructors to teach efficiently and maintain the interest and performance of trainees. Support for the interpretation that a generalized skill of following recipes was developed is indicated by an increase in the percent of steps performed correctly on the first exposure to successive recipes. As is apparent in Figure 3, all three trainees performed more steps correctly in the initial trial on the second and third recipes than on the first and two continued to improve from the second to the third recipe.

Clearly, the small sample size and limited number of recipes limit the conclusions which can be drawn from this research. It does appear, however, that the picture recipe system may be an effective way of teaching severely retarded adults to prepare some foods and thus to participate more independently in their living environments. More complex recipes may certainly be within the potential of severely retarded adults. The approach taken here was to develop functionally useful skills as early as possible in the training sequence.

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BEHAVIOR OBSERVATION SYSTEMS FOR PROGRAM EVALUATION

Behavioral Observations for Work Situations: Coding Definition Manual

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This paper was presented at the American Association on Mental Deficiency, Annual Convention, Portland, Oregon, May, 1975.

Behavioral Observations for Work Situations: Coding Definition Manual

This manual describes procedures for observing and coding behavioral events in a workshop or other work setting employing severely handicapped adults. The coding system applies naturalistic observation techniques to vocational assessment and evaluation by recording the behavior of a worker or trainee, his or her productivity, and events in the surrounding environment. The system is designed to supply ongoing data which will assist in operationally defining the objectives of habilitation programs and provide evaluative data relative to attainment of these objectives.

More specifically, the coding system has four broad purposes: (1) to provide a basis for empirical and theoretical study of the relationship between behavioral and environmental events in a workshop setting; (2) to provide data on behavioral and environmental events which will assist in designing efficient vocational environments for severely and profoundly retarded adults; (3) to provide an outcome measure of the effectiveness of workshop settings in providing simultaneous change in a variety of behaviors of habilitative interest; and (4) to provide a possible empirical basis for the development of environmental assessment procedures advocated by Neff (1970).

The intent of the coding system is to provide a running account of the behavior of an individual worker and the activities of persons in the work environment with whom he interacts. Several dimensions or aspects of behavior are typical of interest in habilitation settings, and the system is designed to provide information about these. It is usually inadequate, for example, to know only the time spent attending to the task at hand. This is indeed of interest, but data-based treatment decisions may also require information about work rates, concurrent stereotypy, and social behaviors. In this system, therefore, behavior code categories have been constructed to record information about several dimensions of a worker's behavior.

A central concern in the use of the system is that the codes be used consistently to refer to precisely the same behavioral events, both across time and across observers. Thus, particular attention is given in this manual to exact definition of code categories and to procedures for insuring interobserver agreement. In general, the development of both the code categories and coding procedures have followed the suggestions of Jones, Reid, and Patterson (1974), who suggest that a naturalistic observation system should be characterized by:

> (a) the recording of behavioral events in their natural settings at the time they occur, not retrospectively; (b) the use of trained impartial observer-coders; and (c) the use of descriptions of behaviors which require little if any inference by the observers to code the events. (p. 4)

Code Category Definitions

The Observation Coding Form

The coding form is divided into two basic sections. The top section lists the "header items" which denote setting variables, subject, observer, date and time of observation. The remainder of the coding form records the sequential behaviors and interactions of both the subject and the supervisor.

The form is comprised of twenty-two lines of behavior codes. Sequential coding reads from left to right across the form, dropping down lines as multiple behaviors and interactions progress. The 15-second time interval is denoted by marking a check in the right hand column after a line is coded. When two or more lines are coded during one interval, a curved mark ( ) should be used to connect all of the lines of behavior which occurred during that 15-second interval.

Header Items

Subject: The observed subject's first name (and last initial, if necessary).

Condition: Specific environmental manipulations affecting the subject (i.e., breaks from work contingent on length of time on task, task completion, etc.).

Task: The workshop name of the task the subject is working on. Names of the tasks are available to the observers at all times.

Time: The time of day (hour and minute) at which each page of observation begins. A new time should be noted at the beginning of each page.

Observer: Observer enters his/her name or initials.

Date: The calendar date (month, day, year) of the observation.

Total Time: The total number of minutes one subject was observed during one session (this should be filled in following completion of the observation).

Sheet — of —: More than one sheet may be used per subject; therefore, the observer should number the sheets sequentially in the first blank as coding progresses. The second blank should be filled in with the total number of sheets coded, following completion of the observation session (e.g., 1 of 3, 2 of 3, 3 of 3, etc.).

Observation Code Categories

The first five categories on the observation sheet (Setting, TK, Attention, Social, and Competence) define specific behaviors which are exhibited by the Subject. Categories 6 and 7 (Source and Behavior Content) define specific stimuli which occur within the subject's immediate environment. Categories 8 and 9 specify the number of people within the specific environment of the subject.

Subject Behaviors

SETTING: The SETTING category describes the context of the workshop situation.

WP: *Work Productive* Setting indicates that all materials and tools necessary for the subject to accomplish the task have been provided. This setting code also assumes that the subject has been adequately trained so the task can be completed independently.

WW: *Work Waiting* Setting indicates that the subject has been adequately trained to accomplish the task independently, but is waiting for additional parts or tools from the supervisor before continuing productive work.

TR: *Training* Setting indicates that the subject has not been adequately trained to accomplish the task independently, and is working directly with a trainer on a task. This will generally be a one-to-one situation, but may occasionally be in a group training situation.

UA: *Unstructured Activity* Setting indicates that no specific behavior is expected from the subject. This will generally occur during breaks, lunch, and the beginning and the end of the day.

TASK: The TASK category indicates the frequency with which the subject completes the task, and is applicable only during Work Productive and Training Settings. The frequency will vary from task to task. Place a check (√) in the box each time the subject completes one task.

ATTENTION: The ATTENTION category indicates the apparent focus of the subject's attending behavior.

A: *Adult* includes all persons in the area who are trainers, work-study students and building personnel, or visitors. This would not include other subjects.

K: *Task* indicates that the subject's attention is focused on his/her own task.

P: *Peer* includes all other subjects.

S: *Self* indicates that the subject's attention is focused on the subject's own body parts and/or behavior.

O: *Other* includes inanimate objects in the environment and whenever the focus of the subject's behavior cannot be determined.

–K: *Negative task* includes playing with the task during WP and TR. Also, excessive arranging and ordering of task parts or tools, and staring at parts without working.

SOCIAL: The SOCIAL category is used to denote talking, smiles, waves, etc., directed toward other people. This also includes talking to oneself or to no one specifically. The ATTENTION category indicates to whom the subject's social behavior is being directed.

+ indicates appropriate and positive interactions by the subject.

– indicates inappropriate, loud, or argumentative interactions by the subject.

O indicates no social behavior is being exhibited by the subject.

COMPETENCE: The COMPETENCE category indicates the repertoire of the subject's behavior, signifying the appropriateness of the behavior to social norms.

+ signifies behavior appropriate to social norms. This would include holding the body in a "normal" fashion (i.e., sitting, walking, talking, or making responses in an appropriate manner, etc.).

– signifies behavior inappropriate to social norms (i.e., likely to call attention to the subject if exhibited in public). This would include rocking and other stereotypy, walking bent over at the waist or knees, limbs held in an awkward position, drooling, screaming rather than talking, etc.

Behavior of Others in the Environment

SOURCE: The SOURCE category indicates the origin of social stimuli occurring in the environment. A, B, C, D, E are prearranged codes for spe-

cific trainers or adults regularly working in the environment. F is any other adult who works in or wanders through the area. P is a peer of the subject. The behavior of the production supervisor is coded at all times he/she is present, whether or not his/her behavior is directed toward the subject. Other trainers, adults, or peer behaviors are coded only when their behavior is directed towards the subject or distracts the subject from a previous activity.

BEHAVIOR: The top line of the BEHAVIOR category (IP, IA, WK, O) signifies what the source is doing.

IP: *Interaction with peer* indicates that the SOURCE (an adult) is interacting with a peer.

IA: *Interaction with adult* indicates that the SOURCE (an adult) is interacting with an adult.

WK: *Work* signifies that the SOURCE (an adult) is working at some task or job and is not interacting with another person. This would include the adults walking around the room watching others, answering the telephone, etc.

O: *Other* indicates that the SOURCE (an adult) is engaged in some activity which does not fit the definitions of IP, IA or WK.

The bottom line of the BEHAVIOR category is used when the SOURCE interacts with the observed subject. This describes the manner in which the SOURCE interacts.

SP: *Support* indicates praise or encouragement, or a communication to the subject to continue exhibiting his/her present behaviors ("Good work", "Keep it up", etc.).

DR: *Direct* indicates a command to do a specific behavior (e.g., "Get back to work", "Sit in this chair", "Work faster"). Also included in this category is a communication to exhibit a different behavior from the present one.

AT: *Attend* indicates silent watching or monitoring, supplying additional parts to the subject without speaking.

O: *Other* behavior exhibited by the SOURCE.

NUMBER OF PEOPLE IN AREA:

#A: The total number of adults in addition to the one coded as SOURCE who are within the area (room) of the subject.

#P: The total number of peers who are within the area (room) of the subject, not including the subject.

Observation Procedures

Materials

Materials required to observe include the special observation coding forms, a clipboard, a pen or pencil, and an interval timing device which emits a sound ("beep") once every 15 seconds.

Instructions for Observers

To begin observing, fill in the top section of the coding form. Note the time at which the formal observation begins at the top of the page next to Time, and activate the 15-second interval timing device. Wait for the first "beep" and then begin coding on line 1. Note the Setting by marking a diagonal (/) slash across the appropriate setting variable. Next record the focus of the subject's

attention (Attention), his/her social behavior (Social), and if his/her behavior is appropriate to the setting (Competence).

During this same 15-second interval (line 1), note the ongoing behaviors of the environment. First code the identification letter of the production supervisor in the area (Source)and what the person is doing (Behavior Content). Finally, record the number of adults and the number of peers (do not count the subject) in the area. If there is time remaining, scan the subject and instructor for behavior changes. As the interval timer "beeps", a mark should be recorded in the far right-hand column to denote the end of the 15-second interval.

Following the 15-second "beep", drop down to line 2 and again observe the subject and supervisor. If there is no change in behavior from the above category, simply leave the category blank. As the check mark in the far right-hand column indicates passage of time, several entire lines may be blank, indicating there is no change in the subject's or supervisor's behavior. If there *is* a change in the subject's or supervisor's behavior, mark the behavior categories which show change.

For example, in the first 15 seconds the subject is attending to task in a work productive setting and is non-social and competent. Supervisor A is interacting with one of five peers. There are no other adults in the room. The second 15 seconds the subject continues working on task and the supervisor continues talking with a peer. The third 15 seconds the subject continues working on task and the trainer begins talking to an adult who has just walked into the room. These three intervals should be coded as shown in Table 1.

Table 1

CODING ILLUSTRATION

CONDITION _____ TOTAL TIME _____
SUBJECT _____ TASK _____ OBS. _____ DATE _____ TIME _____
SHEET _____ OF _____

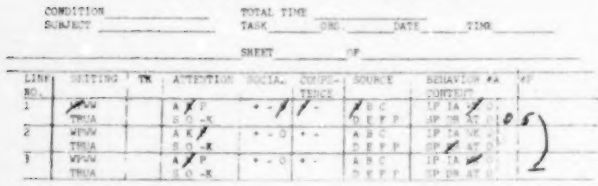
LINE NO.	SETTING	TK	ATTENTION	SOCIAL	COMPETENCE	SOURCE	BEHAVIOR #A CONTENT	#P
1	✓WPWW		A ✓ P	+ - ✓	✓ -	✓ B C	✓ IA WK O	0 5
	TRUA		S O -K			D E F P	SP DR AT O	
2	WPWW		A K P	+ - O	+ -	A B C	IP IA WK O	-
	TRUA		S O -K			D E F P	SP DR AT O	
3	WPWW		A K P	+ - O	+ -	A B C	IP ✓A WK O	1 -
	TRUA		S O -K			D E F P	SP DR AT O	
4	WPWW		A K P	+ - O	+ -	A B C	IP IA WK O	
	TRUA		S O -K			D E F P	SP DR AT O	
5	WPWW		A K P	+ - O	+ -	A B C	IP IA WK O	
	TRUA		S O -K			D E F P	SP DR AT O	

To code several behavior changes in one 15-second interval, code from left to right, drop down a line and again code from left to right, etc. As the interval ends, connect all lines coded with a curved ( )) line in the far right-hand column.

For example, in the first 15 seconds (line 1), the subject is in a work productive setting, attending to task, being non-social and competent. Supervisor A is working. There are no adults and five peers in the area. The subject begins looking at a peer's work but does not say anything. The supervisor notices the subject's attention is off task and directs the subject to "get back to work". The subject immediately goes back to work and the supervisor continues working. This 15-second interval should be coded as shown in Table 2.

Table 2

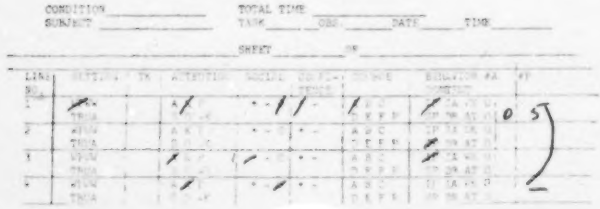
CODING ILLUSTRATION



In another example, the subject is continuing in a work productive setting, non-social and competent, while attending to task. Supervisor A is interacting with a peer. Supervisor A then notices the subject working and praises him for working. The subject looks at Supervisor A and says "yeah". Supervisor A goes back to the peer and the subject goes back to task working. Both subject and supervisor continue this behavior through the next two intervals. These three 15-second intervals should be coded as shown in Table 3.

Table 3

CODING ILLUSTRATION



Any non-social behavior must persist for a minimum of three seconds to qualify as a coded behavior. For example, the subject is working at task, looks up quickly to see an adult leave the room and immediately returns to task. In this example, the subject's look-around behavior would *not* be coded because it did not maintain for three seconds.

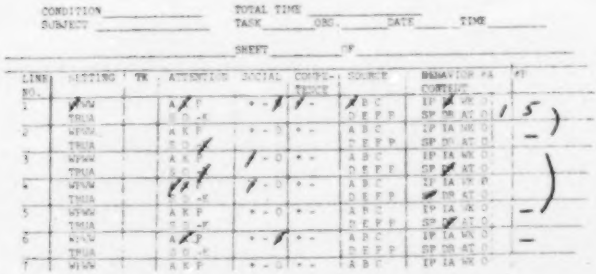
Any social behavior by the subject is recorded regardless of its duration. If the subject says "Hello", or waves to an adult or peer, this is coded in the Attention column on A or P respectively, as well as a (+) in the Social column. Also, smiles, nods, or any overt verbal or nonverbal response to another are coded regardless of their duration. When such interactions do not last three seconds, double coding of task (K) and the person is used as explained in the following paragraph. Furthermore, supports (SP), Directs (DR), and Interact Peers (IP) in the Behavior Content column need not last a full three seconds to warrant coding.

In coding the subject's Attention category, it is possible to record two Attention behaviors simultaneously. For example, the subject may be attending to a supervisor (A) praising him for good work while continuing to work on the task. In this instance, both A and K would be coded simultaneously on one line. Other similar combinations would be P and K, and O and K. K and −K would not be coded on the same line because they are incompatible. If the subject were working with the task (K) appropriately, and within the same 15-second interval began playing with the task (−K), separate lines would be used to code the two behaviors.

For example, the subject is in a work productive setting working on task, being non-social and competent. Supervisor A is interacting with the other adult in the area. There are five peers present. Within the same interval, the subject begins playing "airplane" with a task piece. Supervisor A continues talking with the adult. At the beginning of the next interval the subject is continuing to play "airplane" with the task piece. Supervisor A notices the subject's behavior and directs him to go back to work. The subject immediately begins working with the task while commenting and looking at the supervisor. The supervisor turns away and begins working as the interval ends. At the beginning of the following interval the subject directs all attention to the task and the supervisor continues working. These three intervals should be coded as shown in Table 4.

Table 4

CODING ILLUSTRATION

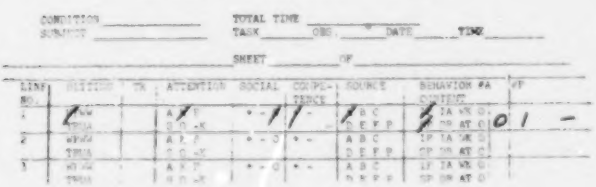


In coding the environmental behavior category, it is also possible to record two behaviors simultaneously. For example, two adults may be interacting with a peer and with each other simultaneously. In this instance, both IP and IA are coded. In another example, the supervisor may praise the subject and one or more peers with one praise ("You two are really working hard."). In this case, IP and SP are coded together on the same line.

For example, the subject is in a work productive setting, attending to task, non-social and competent. The other peer in the area is also attending to task. Supervisor A says, "I really like the way both of you are working." Both subject and peer continue working. This interval should be coded as shown in Table 5.

Table 5

CODING ILLUSTRATION



Observer Agreement

Observer training and agreement procedures are designed to minimize error that can occur because of idiosyncratic use of the coding system by individual coders. Several such errors must be considered to assure the validity of the data, including improper use of the system by the coder, differences in system by different coders or at different times, and the possible decrease in coding accuracy while the coder is not being checked for agreement.

Training Observers

The training of coders begins with the memorization of the code and observation procedures. Coders are taught specific behaviors included in each code category. After memorization, they practice coding the trainer until a specified level of agreement between their records and those of the trainer is reached. In our research, this is 90 percent agreement for three consecutive one-hour periods.

Checking Observer Agreement

Simply insuring that all observers learn to use the code well enough to reach a stated criterion is not enough to insure that the observational data obtained actually reflects the behaviors observed. Different observers may use the code differently; an observer's definition of various code categories may gradually change over time; or a variety of temporary circumstances may cause day-to-day changes in coding.

All these possible sources of error in use of the coding system are checked by having two observers observe the same events simultaneously and independently. In our research, the trainer continues to code with the observers at certain times, computing agreement on all code categories, and giving specific feedback concerning deviations. To add incentive for maintaining coding accuracy, our coders may be given a small pay raise contingent on remaining reliable (above 90 percent agreement with the trainer).

It is possible that an observer would use the coding system differently when aware that agreement is being checked. Covert modes of reliability thus may be useful to assure that the agreement data is representative of the entire data set. In our research, this possibility is being checked by having the trainer do half the reliability checks from a different observation room, unknown to the observers, and half the checks in the same room as the observers.

Computing Observer Agreement

Two approaches to computing observer agreement are available, and both are used in aspects of our research. The first is entry-by-entry agreement, in which the entire protocols of two observers are compared across all entries. In a relatively uneventful 5-minute period, at least 180 units of information would be coded by each observer (twenty 15-second intervals with nine dimensions coded during each interval). Entry-by-entry agreement is computed by dividing the total number of agreements across all code categories in two such protocols by the total number of agreements plus disagreements:

$$\text{percent agreement} = 100 \times \frac{\text{number of agreements}}{\text{number of agreements} + \text{disagreements}}$$

Thus, if the two protocols disagreed on 30 of the 180 entries used in the illus-

tration above, observer agreement would be $100 \times \frac{150}{180} = 83$ percent. Entry-by-entry agreement is useful primarily in observer training programs, inasmuch as it provides a gross index of an observer's accuracy in using the code.

Entry-by-entry agreement is seldom appropriate for other uses of the code because these usually involve analysis of some subset of the total available data. In our research, for example, we are interested in the number of supervisor-subject interactions which occur during each task completion cycle. Observer agreement on the information needed to obtain this score is thus of interest, not agreement on the total code. Agreement on such a unit score may be higher or lower than corresponding line-by-line agreement.

To compute unit score agreement, each observer's protocol is used to derive the scores of interest. Agreement between these scores may then be computed by the percent method outlined above, or by correlating the two sets of scores. A more detailed explanation of both percent and correlation methods is available in Johnson and Bolstad (1973).

References

Johnson, S., & Bolstad, O. Methodological issues in naturalistic observation: Some problems and solutions for field research. In L. Hamerlynk, L. Handy, & E. Mash (Eds.), *Behavior change: Methodology, concepts and practice.* Champaign, Illinois: Research Press, 1973.

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Behavioral Observations for Work Situations: Revision for Group Observation

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Behavioral Observations for Work Situations: Revision for Group Observation

The code developed by Todd, Bellamy and Leiter (1975), provides extensive information on the behavior of a single worker and the events in the work environment. However, it is less useful for observing a group of subjects, and a second code was needed to record more general information about all workers in a given production setting. Using the code described here, a group of sixteen workers and their trainers may be observed by two coders, and information concerning the workers' behavior and the interactions between workers and trainers can be recorded.

The group code is built about the same parameters as the individual code, and meets the same requirements for unobtrusive observations in a natural environment.

Time sampling procedures are used in the coding system to obtain measures of each workers' attention to the work task and the occurrence of previously identified target behaviors. The behavior of each supervisor is continuously recorded, and contacts with workers are categorized as either supportive or directive. Thus, while the code allows for observation of a group of workers, individual scores result for both workers and trainers.

Observation Procedures

Observation and recording of behavior continues throughout all work periods. Two observers will work during each period, with each observing half of the workers in the production room. The facilities of the Specialized Training Program enable observation from a concealed deck, so that the coders cannot be seen from the production area.

The coding supervisor will code simultaneously with each observer during at least one 5-minute period each week. The observer's rate of pay is contingent on attaining and maintaining agreement with the supervisor. Methods of computing agreement are discussed below.

To begin observation, the coder should have: The clipboard timing device, which emits a sound each 15 seconds; a supply of coding forms; and two ball point pens.

The Coding Form

The coding form provides space for recording general identification data, for recording behavior and for summarizing behavior after the observation session. The recording section is divided into two sections, "Task-Target" and "Trainer". During one 15-second interval the behavior pertaining to the first section is observed and recorded, and during the second interval that pertaining to the second section is noted, returning to the first section during the third interval and so on.

Task Behavior Section

The first eight columns of the sheet are for recording task and target behaviors. At the beginning of the coding session, the initials of each assigned subject are entered into the blank space at the top of the columns on the "subj" row. In the next row, "Tsk," the code number of the task performed by each subject will be entered. If the task is changed during a coding session, a new number is entered on that point on the coding record. Each column is divided horizontally into 15 spaces, each of which represents a 15 second coding interval. Into these spaces the following symbols are entered as appropriate:

Blank space: On task. The worker's attention is focused on the task and the expected work is being done, or on the trainer and task when instructions and help are delivered.

Horizontal Line (–): Off Task. Worker's attention is not on the task, or the subject is playing or performing inappropriate activities with the task. Looking about the room, watching people, etc., are included.

O: Out of the room. Finished shift, on break, in bathroom.

Diagonal Line (/): A worker marked O returns to the workshop to work.

The horizontal line and the diagonal line pertain only to the space in which they are written; a following empty space is counted as on-task. The O, however, is continuous until turned off by a diagonal line, so that an empty space after an O means the subject is still out of the room.

Target Behavior Section

A target behavior is one which the trainers wish to increase or decrease. Such things as shouting, self-stimulation, or other behavior incompatible with completing one's work might be targeted for decrease, while appropriate verbals, handraising, etc., could be marked for increase. There is a list of target behaviors for most workers which is revised as needed. Although a given behavior may not be the focus of intervention at a given time, the baseline data may be useful later.

When a target behavior does not occur during a fifteen-second interval, the space is left blank. A vertical line (|) is used when a target behavior does occur more than once during an interval, only one vertical line is entered.

When a target behavior occurs in an interval during which the subject is also off-task, both signs are entered resulting in a (+) sign.

Trainer Section

During the second 15-second coding interval, the coders focus on the two major trainers in the room. A schedule of these two people is posted, and all other staff and visitors are to be ignored.

Each row is split into two subrows in the trainer section of the page. In the top subrow the behavior of one trainer is recorded while in the lower subrow that of the other trainer is recorded during the interval. On row one the code numbers of the two trainers are entered under the "#" column. This arrangement is considered constant until another number is entered into the corresponding subrow when one trainer is replaced by another. A zero in the "#" column means that the trainer is out of the room. These numbers are entered at the beginning of each page.

The next 15 columns of the trainer section are headed by the initials of the 15 subjects. When a trainer interacts with a subject, a mark is in the appropriate intersection of the subject column and the trainer subrow. There are two signs

Vertical Line (|):*Support*, i.e., encouragement, neutral statements, any furthering the occurrence of the behavior engaged in currently by the subject, touching.

Horizontal Line (−): *Direct*, any statement indicating the subject should change what was being done, correcting mistakes, giving orders.

When both occur a (+) sign results; when neither occur an empty space results. Only one mark is made per interval, even if the behavior occurs more than once.

The last column, N.S. (non specific), is for those comments of a general nature which do not involve interaction with any single worker. These might include, for example, "Everybody's working well" (support). "Nobody gets paid until they have their hand up and are sitting quietly" (direct).

The code is designed for use in a workshop with one or two trainers in the room at a time. On occasion, especially in training of personnel, there may be more trainers whose behavior must be recorded. Instead of adding subrows, one can use alternate symbols for people other than the two trainers, recording them in the existing spaces: "O" is equivalent to |, indicating support and "/" indicates direct, like −. Possible combinations thus include O, O, O, −, and /.

Header Items

Coder .....: Enter initials of coder
Date .....: Date
Time .....: Enter at the beginning of each page to the closest minute.
Page ..... of .....: Enter each page number as you go into the first blank, and at the end of the coding session, enter the total number of pages in the second blank.

Computing Observer Agreement

Two approaches to computing observer agreement are available, and both are used in aspects of our research. The first derives percent agreement by dividing the number of agreements by the number of disagreements plus the number of agreements

$$\text{percent agreement} = 100 \times \frac{\text{number of agreements}}{\text{number of agreements} + \text{disagreements}}$$

Since the scores used in our research are the sums for each category on each page rather than the overall agreement across categories, these sums are the focus of the reliability computation. On each page there are fifteen coding intervals during which a behavior may be recorded, so the denominator is always 15 for off task or target behaviors in a full page of coding. The numerator may vary from 0-15, depending on the observed incidence of a code category. For example, if coder one observed subject M to be off task eight times on a page (and therefore on task seven times), and coder two observed subject M to be off task five times on that page, there would be three disagreements and twelve agreements yielding:

$$\text{percent agreement} = \frac{100 \times 12}{15} = 80\%$$

On the trainer half of the page the denominator is 30 on a full page of coding, since a behavior may occur twice per interval when two trainers are present, and the numerator may vary from 0-30. Similar computations are used with the time and trainer variables.

These procedures are simple and useful for tracking agreement through the course of the research but may be deceptive in that low incidence behaviors have very high chance reliabilities. It is useful to compute the chance level of agreement to compare with obtained levels as explained by Johnson and Bolstad (1973). If a behavior, such as on task, occurs 90% of the time, the level of chance agreement is $.90^2 + .10^2 + .82$ or 82%. Also, since the incidence of behavior may change widely from page to page or day to day, it is good to record cumulative reliability values over the course of the research on each variable.

The second measure of observer agreement is obtained by correlating the scores of the two observers on each of the data categories being used in the study. A more detailed explanation of both percent and correlation methods is available in Johnson and Bolstad (1973).

Data Analysis

Before data obtained in the coding system is useful to workshop employees, a certain degree of computational work must be done. We have divided this process into a number of steps: Summation, key punching, and computation.

Summation:

Task-Target: At the bottom of the columns are three rows labeled O-t, TAR, and TIME, respectively.

O-T: Into this row the number of off task symbols (−) in that column is entered. This number will range from zero to fifteen.

TAR: Into this row the number of target symbols (|) in that column is entered. This number may also range from zero to fifteen.

TIME: Into this column goes the number of intervals during which the subject is in the room, or the number of intervals *not* covered by the zero sign. When a person is in the room the whole page, this number would be fifteen, and if they are not there at all it is zero.

TRAINER: At the bottom of this side of the page are two rows labeled S and D.

S: Into this row is entered the number of supports (O or |) in each column.

D: Into this row is entered the number of directs (/ or −) in each column.

At the top of the page are four rows headed by "T.#.", "Dir.", "Sup.", and "Time". Under the first of these (T.#.) is entered the trainer numbers which are recorded on that page, one per row. Under "Dir." is recorded the number of directs recorded for each trainer. This is obtained by counting the direct marks (−) for each trainer across each subrow which is assigned to that trainer. (/) marks are not counted here, even if these marks occur in a trainer's subrow as they pertain to a third trainer.

Under "Sup." is recorded the number of supports for each trainer on the page obtained by counting all of the support marks (|) recorded for that trainer. (O marks are not counted.)

Under "Time" is recorded the number of rows during which the trainer is counted in the room. This number may range from 0 to 15.

Computation

The various values derived above can then be summed across pages for periods of any length of time desired. In our research we compute values for each day, trainer shift, or task assignment as appropriate.

The ratios we use are:

1) Percent off task for each worker: $= \frac{\text{Total O-T}}{\text{Total TIME}}$

2) Percent of intervals in which the target behavior occurred for each subject: $= \frac{\text{Total TAR}}{\text{Total TIME}}$

3) Supports per minute received by each worker: $= \frac{\text{Total X. x 4}}{\text{Total TIME x 2}}$

4) Directs per minute received by each worker: $= \frac{\text{Total D. x 4}}{\text{Total TIME x 2}}$

For trainers we compute:

1) Supports per minute $= \frac{\text{Total Sup. x 4}}{\text{Total TIME}}$

2) Directs per minute $= \frac{\text{Total Dir. x 4}}{\text{Total TIME}}$

These procedures can be easily programmed on a computer, giving a regular print-out of relevant data as desired.

References

Johnson, S., & Bolstad, O. Methodological issues in naturalistic observation: Some problems and solutions for field research. In L. Hamerlynk, L. Handy, and E. Mash (Eds.), *Behavior change: Methodology, concepts and practice*. Champaign, Illinois: Research Press, 1973.

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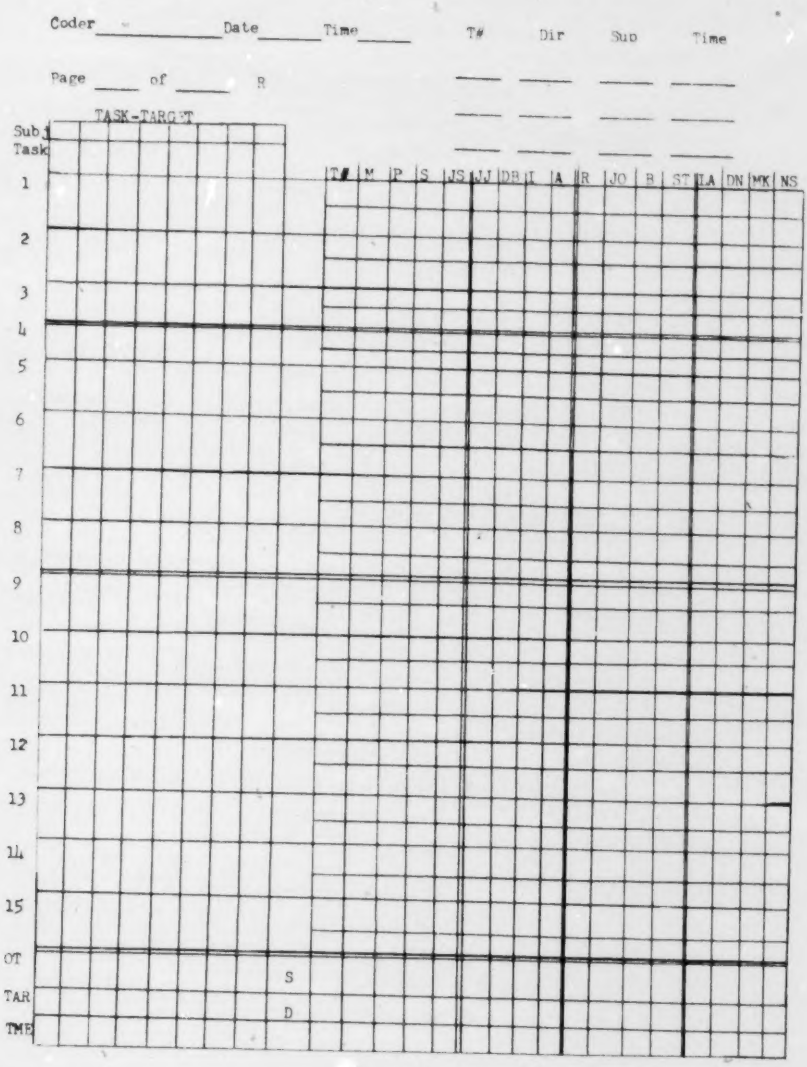

Figure 1

CODING FORM ILLUSTRATION